



INTERNATIONAL INSTITUTE OF AGRICULTURE  
BUREAU OF AGRICULTURAL INTELLIGENCE AND PLANT DISEASES

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## ABSTRACTS

### AGRICULTURAL INTELLIGENCE

#### GENERAL INFORMATION.

- 15 The Distribution in Wheat, Rice and Maize Grains of the Substance, the Deficiency of which in a Diet causes Polyneuritis in Birds and Beri-beri in Man. — CHICK, HARRIETTE and HOME, E. MARGARET, in *Proceedings of the Royal Society, Series B.* Vol. LXXX, No. B. 624, pp. 44-68. London, December 1, 1917.

RURAL  
HYGIENE

The experiments described were carried out at the Lister Institute, and the results obtained led to the following conclusions:—

Wheat endosperm, which constitutes white flour, is deficient in anti-neuritic vitamins (the substance whose deficiency in a diet causes polyneuritis in pigeons and beri-beri in man) (1); when fed to pigeons as an exclusive diet it caused polyneuritis in a manner identical with polished rice.

In both the wheat and rice grain, the anti-neuritic vitamine is concentrated mainly in the germ or embryo; it is present in less quantity in bran pericarp and aleurone-layer, probably in the aleurone-layer. The embryo of maize grain also possesses marked anti-neurotic properties, both in the utellum and in the plantlet. For this reason it is important to include the germ in the flour from which wheaten bread or biscuit is made, especially when the diet may consist largely of preserved foods, which are deficient in the vitamine.

The daily ration of wheat-germ that must be added to a diet of polished rice in order to prevent the onset of polyneuritis is equal to the amount which, administered by the mouth, will cure a pigeon acutely ill with polyneuritis, brought on by an exclusive diet of polished rice. This relation is not peculiar to wheat germ, but applies to other foodstuffs, such as yeast, containing anti-neuritic vitamins. The addition of wheat-germ to a diet of polished rice in quantity (3 gm. every second day) sufficient to prevent

(1) See R. Jan., 1918, No. 2. (Ed.).

polyneuritis, also maintained the weight and general health of the birds. Rations in excess of this (2 to 3 gm. every day) led to a great increase in body-weight and in the general well being and vitality of the birds.

Exposure of wheat embryo to a temperature of about 100° C. for 72 hours caused an insignificant loss in anti-neuritic vitamine; therefore, it be included in the flour from which bread or biscuit is made, it can be relied upon to retain its anti-neuritic properties after baking.

At temperatures in the neighbourhood of 120° C., however, there was a swift destruction of anti-neuritic properties. This fact must be borne in mind in dealing with diets largely composed of preserved and tinned food previously sterilised at temperatures above 100° C.

126 - **Some Remarks on Macedonian Anopheles.** — COR and HOVASSE, in *Bulletin de la Société de Pathologie Exotique*, Vol. X, No. 10, pp. 890-896. Paris, December 12, 1917.

Macedonia, together with Greece, is the worst malarial district of Europe. The authors examined: — 1) the nature of Anophelines and the larvae; 2) their life cycle and the influences modifying it; 3) the percentage of Anopheline carriers of hematozoa. Their observations showed the following interesting points: —

The principal carriers of malaria in the Salonica district are *Anopheles maculipennis* and a special variety of *Pyreophorus superpictus* which is proposed to call *P. macedoniensis*.

The life cycle varies greatly, especially the larval stage, and is largely dependent on the temperature. Contrary to the opinion generally held at an altitude of 1956 to 3260 feet (Mount Hortiack), as well as a decrease of 10° C. at night, are not sufficient to stop evolution. It seems that the Anophelines of Salonica are adapted to the great variations of day and night temperature characteristic of the country.

The proportion of Anopheles found to be infected was 8 %; they were found especially at Mikra where the cases of malaria were very frequent in proportion to those found elsewhere.

127 - **Agricultural Education in the United States.** — PORRITT, EDWARD, in *The Quarterly Review*, No. 453, pp. 315-333. London, October, 1917.

The Department of Agriculture at Washington has been a department of first rank in the executive branch of the Government of the United States since a department presided over by a Cabinet Minister — since 1889. In the 28 years it has gradually acquired one outstanding distinction. With the single exception of the Post Office, it is to-day in more close and frequent touch with the hundred million inhabitants of the United States, and renders them more constant and direct service, than any other department of state at Washington.

This article is concerned only with the educational work of the Department of Agriculture. The simplest method of describing the work of Congress and of the Department on behalf of good agriculture and efficient farm economy is to take the budget of one of the state agricultural colleges and show the connection of Congress and the Department with the 66 agricultural colleges and with the farm experiment stations associated with them.

leges, and the connection of the colleges and the Department with the scheme of educational extension work now being carried out under the Smith-Lever Act of 1914.

The budget of the agricultural college of the State of Illinois, for the year 1916-1917, shows that it received grants from the Federal Government towards the cost of its maintenance under three heads:

1) For the endowment of teaching in agriculture and the mechanic arts (MORRILL and NELSON funds) annually. . . . .	\$50 000 000
2) For investigation in agriculture (HATCH and ADAMS funds) . . . . .	30 000 000
3) For demonstration work in agriculture and home economics (SMITH and LEVER funds, 1916-17) . . . . .	58 184 030
Total . . . . .	\$138 184 030

In some states there is more than one agricultural college. The total number in 1917 was 66. In 1857 the first bill passed by Congress aiding the state governments to establish colleges for the teaching of agriculture was vetoed by President BUCHANAN. The bill had been introduced by J. S. MORRILL, of Vermont. Four years later, after the election of LINCOLN, and of a new House of Representatives, MORRILL reintroduced his bill. A similar bill was introduced in the Senate; and in June 1862 there was enacted the law under which what have since been known as the Land Grant Colleges came into existence.

The Federal Government at that time had enormous areas of public land at its disposal; and, with money accruing from these lands, the agricultural colleges, now under the control of the state governments, were founded.

By the Act of 1862 each of the then existing states received from the Federal Government a large donation of public land. Representation in the Lower House at Washington is based on population; and under the Morrill Act there was apportioned to each state an area of land equal to 3600 acres for each senator and representative in Congress to whom the state was entitled by the apportionment under the census of 1860. As the lands so assigned were sold, the money accruing was directed by the Morrill Act to be invested in bonds of the United States or in state bonds. The money was to form a perpetual fund; and the interest accruing from it was to be applied to the support and maintenance of at least one college in each state,

"where the leading object shall be, without excluding other scientific and classical studies, and including military tactics, to teach such branches of learning as are related to agriculture and the mechanic arts, in such manner as the legislatures of the states may respectively prescribe, in order to promote the liberal and practical education of the industrial classes in the several pursuits and professions of life".

By the Morrill Act, and also by four subsequent Acts for aiding the states in promoting the teaching of agriculture, the cost of buildings for agricultural colleges has always been a charge on the states.

Over agricultural colleges established under the Morrill Act the Federal Government had no supervision or control. It was left to the state



legislatures to prescribe the course of teaching. There was no audit in the interest of the Federal Government, no examination, test or inspection to ascertain whether the Federal Government, as representing the people of all the states, was getting value for its money. All the duties of a state government to the nation outside its own borders in respect to its agricultural college, largely maintained by the Federal Government, had been discharged when copies of the annual report of the college, "recording any improvement and experiments made, with their costs and results", had been forwarded to the Secretary of the Interior at Washington, and also to the other colleges endowed by the land grants of 1862.

Between 1862, when the Federal Government made possible an agricultural college in every state, and 1914, when the Smith-Lever Act was passed, three additional grants were made to the State agricultural colleges for the extension of their work. The first was in 1887. Congress then passed an Act providing for the establishment of agricultural experiment stations in connection with the agricultural colleges. A grant of \$15 000 a year was made to each state for the maintenance of an experiment station. The work to be undertaken was defined in the Act as follows:

"To conduct original researches or verify experiments in the physiology of plants and animals; the diseases to which they are severally subject, with remedies for the same; the chemical composition of useful plants at their different stages of growth; the comparative advantages of rotative cropping, as pursued under a varying series of crops; the capacity of new plants or trees for acclimation; the analysis of soils and water; the chemical composition of manures, natural or artificial, with experiments designed to test their comparative effect on crops of different kinds; the adaptation and value of grasses and forage plants; the composition and digestibility of the different kinds of food for domestic animals; the scientific and economic questions involved in the production of butter and cheese; and such other researches or experiments bearing directly on the agricultural industry of the United States may in each case be deemed advisable, having due regard to the varying conditions and needs of the respective states or territories".

It was under this law of 1887 that, for the first time, the Department of Agriculture at Washington was brought into direct connection with the work of the agricultural colleges. The connection was effected by a section of the Act which directs that, in order to secure, so far as possible, uniformity of methods and results in the work of the experiment stations, it shall be the duty of the Secretary of Agriculture to furnish forms for the tabulation of the results of investigations or experiments; to indicate from time to time such lines of enquiry as shall seem most important to him; and in general to furnish such advice and assistance as will best promote the purposes of the Act.

A few years afterwards, the American Association of Agricultural Colleges and Experiment Stations was organised; and, chiefly at the instance of this association, Congress in 1906 increased the appropriation for each experiment station from \$15 000 to \$30 000 a year. Earlier than this in 1890 — by the Nelson Act, an additional annual appropriation was made to each of the agricultural colleges. The net result of these Acts of Congress of 1862, 1887 and 1906, for the advancement of the teaching of agriculture

as that in 1914 — the year before the Smith-Lever Act — each state was receiving from the federal treasury \$50 000 a year for its agricultural college, and \$30 000 for its experiment station.

Since in all this legislation the cost of the buildings at agricultural colleges and at experiment stations, with their maintenance and repair, is thrown on the state and all the state legislatures make annual appropriations for their colleges, it will be realised that this liberal expenditure in the interest of agriculture by federal and state governments has popular support.

In these years, before the United States Government made appropriations to the states for extension work, there existed in the Department of Agriculture a division which was exclusively concerned with the work at the State experiment stations. Its functions, which since the Smith-Lever Act came into operation have been taken over by the States Relations Service Bureau of the Department, were to carry out the provisions of the Acts of 1887 and 1906; to enable the Secretary of Agriculture to certify to the treasury department when federal grants might properly be paid to the State experiment stations; to report to Congress regarding the work and expenditures of the stations; and to aid the stations in the effective development of their work.

Inspectors from the bureau visit each experiment station at least once a year. Its work and its expenditure are carefully examined; and on the basis of reports made by these inspectors, warrants are issued on the United States treasury for the payment of the grants to the various States. Stations must submit their schemes of work to the Secretary of Agriculture, practically to the States Relations Service Bureau.

While the agricultural colleges were extending their work by means of the federal grants of 1887, 1890 and 1906, and of liberal appropriations on the part of the state legislatures, larger appropriations were made by Congress to the Department of Agriculture, and its work was greatly extended. The first appropriation for the Department for 1887-1888, the year in which Congress made its first grant to the colleges for experiment stations, was \$37 000. Ten years later, in 1898-1899, the appropriation had risen to nearly \$2 500 000. In 1908 it was nearly \$10 000 000; and for 1913-14, the year before the Smith-Lever Act came into operation, it was \$16 651 000.

With the enactment of the Smith-Lever law the Department entered a new era. It began to have a direct, as distinct from an indirect part, what may be described as the popular teaching of agriculture and farm economy. From 1887 to 1914 its work for agricultural education was, for the main, done through the State experiment stations and by means of bulletins and reports sent through the post to farmers, cotton growers, fruit growers, cattlemen, foresters and lumbermen, market gardeners, fruit growers, and poultry men. The most widely-circulated of the Department's publications is the "Farmers' Bulletin". The bulletins are written in plain language, and are adapted to the different sections of the country, their specific object being to tell farmers how and when to do things; in 1914 in the aggregate 14 795 000 bulletins were sent through the mails.

What are known as Department Bulletins are more specialised than the

Farmers' Bulletins. They are concerned with subjects of interest to the growers, truck growers (*i. e.* market gardeners), poultry men, and lumbermen. They are intended for men who are specialists, actively engaged in these various industries, and who, while not technical men, can be described as professional workers. Included in the Department Bulletins are what are known as Professional Papers, in which information on highly technical subjects is communicated to scientists or technologists in the same or allied fields of enquiry. These bulletins are issued in editions averaging six thousand copies. They are distributed free to applicants.

Purely scientific and technical subjects are handled in the "Journal of Agricultural Research", which is issued weekly, and is sent free to agricultural colleges and experiment stations, and to technical schools and universities.

The "Experiment Station Record" is a technical review of the world scientific literature pertaining to agriculture. Its free distribution is restricted to the staffs at agricultural colleges and experiment stations. The "Weekly News Letter" is a quarto sheet of four pages, three columns to a page. It contains news of the more important activities of the Department, with articles on farm practice and home economics. Its circulation is restricted to the employees of the Department in Washington and in the field, to crop correspondents, and to various agencies that cooperate in the work of the Department. The "Monthly Crop Report", distributed to all persons sufficiently interested to ask that their names should be placed on the mailing list, publishes data concerning current agricultural conditions. Its chief features are estimates of acreage, reports of conditions and statistics as to yields and prices. At the end of each month comes the list of publications. It gives a brief description of each publication issued during the month, and an indication of the region of the country to which it is adapted. It is by means of this list that miscellaneous applicants are enabled to keep in touch with the Department and to ask for those publications in which they are interested.

The duties and functions of the Department between 1887 and 1902 came to include much that might not inaptly be described as police work chiefly in connexion with the administration of the federal pure-food code, the stamping-out of disease among cattle, and the eradication of insects and diseases that work havoc in the plant world. But it was chiefly through its supervision of the work of the state experiment stations and through its various widely-circulated publications, that the Department made its contribution to the propaganda for improved farming and better economic and social conditions in the farming communities.

For some years before the new era in the history of the Department which began after the passage of the Smith-Lever Act, several of the larger agricultural colleges, with some help from semi-public organisations like the Rockefeller Foundation, or from chambers of commerce, or from state associations for the improvement of agriculture, had been engaged in extension work. The college faculties had organised itinerant schools for the teaching of agriculture. Not content with the work they were doing with

in four-year students or their short-course students they had sent their teachers into the rural communities, where they conducted schools for as short a period as two weeks and then moved on to another community. In a considerable number of states county agencies had also been established. Graduates of agricultural colleges, after they had had two or three years of actual experience on farms, were, if suitable, appointed resident county agents at salaries from \$1200 to \$1800 a year, and commissioned to devote the whole of their time to visiting farms, instructing farmers in new and improved methods of work, and in improving the general farm economy of the counties in which they are placed.

Women graduates of the agricultural colleges who had specialised while at college in the care of poultry and in farm economy were similarly appointed, to devote their time to the education of the women of the farms on matters pertaining to farm home management.

It was found, as early as 1912, that this extension work by the agricultural colleges was highly appreciated in the farming communities of the States in the south and west in which it had been undertaken. It was perceived that this direct teaching was resulting in more efficient farming, and, finally that it was obviously tending to make farm life more attractive to the boys and girls of the farms. It was also realised at Washington that colleges which embarked in this direct teaching of agriculture and farm economy should not be dependent on semi-public sources for the funds with which to carry it on, but that it was a mission in which the Department of Agriculture should have some part, and over which the Department should exercise some supervision, as since 1887 it has had over the State experiment stations.

Under the Smith-Lever Bill a grant of \$10 000 a year is made to each of the States for extension work, and a second grant, based on the rural population of the State, is made subject to the condition that a corresponding grant for extension work is made by the State legislature. For the years 1916-17 the total grant was \$1 580 000. Each year until 1921 the grant will be increased; and, when the maximum is reached, a little over \$2 500 000 a year from the Federal treasury will be available as the contribution of the Federal Government towards the cost of the extension work of the State colleges of agriculture.

The Bill proposed to set up a system of general demonstration teaching throughout the country, while the agent in the field of the Department and the college was to be the mouthpiece through which this information was to reach the people — the man and woman and the boy and girl on the farm. The plan proposed undertook to educate the farmer by personal contact — by going on to his farm, under his own soil and climatic conditions, and demonstrating that there are methods which in results surpass his own.

The problems with which the Department of Agriculture and the teachers of agriculture and farm economy are confronted are various. Among these are the one-crop areas; the large proportion of farmers who are owners of the land they cultivate, but make a poor living and have little money for their disposal; the chronic shortage of labour in all farming communi-

ties; the large number of farms in the hands of new-comers from European countries who cannot read English; and the large areas in the southern cotton-growing states, where tens of thousands of small plantations — one-mule farms — are rented by negroes.

The Smith-Lever law came into operation in the fiscal year 1914-15. Some details of its working were given to the committee of agriculture of the House of Representatives by Mr. C. B. SMITH, chief of the Office of Extension Work, one of the subdivisions of the States Relation Service Bureau of the Department as follows: —

"The department and the college employ a state leader who is in charge of all county work. The state leader selects the county agent, inaugurates and directs his work, subject to the approval of his superior officers, who are the director of the Extension Service and the director of the States Relation Service in the department at Washington. The state leader has to find men who understand the science of agriculture and the practice of agriculture. He takes graduates of the colleges who have remained in the state, and who have made a success in the practice of agriculture. He takes the agent down to the county where he is to be employed, and lets the people look him over, and see whether or not he is acceptable to them. His employment is the joint action of the county, the state, and the Department of Agriculture. The county agent's business is to bring to his county everything that is appropriate to that locality. If the farmers need a cow-testing association, he will help them to organize it. If they need a breeding association, he will help them with it. The one big thing that the county agent needs... is to have a good organisation of farmers behind him, supporting him in his work, and helping him to shape up the work itself". The agent also introduces new and better varieties of seed, as well as improved cultural methods, etc.

Extension work with the women on the farms in the south was begun in 1910. In 1915 there were 350 women county agents at work in the southern states. They deal with the problems of the farm and farm economy. They teach home-gardening, the canning of fruits and vegetables from the gardens; they give demonstrations of labour-saving devices in the home-made affairs — leading to better conditions and greater economy in the home itself. "Women county agents are to-day reaching approximately thirty-five thousand homes in the south".

A new value attached to the work and opportunities of the county agents as soon as the United States became involved in the war. In the agents both the Department of Agriculture and the agricultural colleges had a ready medium through which farmers and food-growers could be directly reached and immediately interested in the new movement. Local committees secured land in or near the cities for free allotments; and through the work of these committees, lawns were broken up for vegetable gardens. County agents, and supervisors working under them gave instruction as to the spot to the amateur gardeners, and in many places they also helped them in securing seed and fertilisers.

In the fiscal year 1916-17 approximately \$34 000 000 were being expended by the Government of the United States on the Department of Agriculture, on the agricultural colleges and experiment stations, and on extension work under the Smith-Lever Act.

Appropriation to the department of agriculture . . . . .	\$25 000 000
MORRILL and NELSON funds for colleges of agriculture . . . . .	2 400 000
HATCH and ADAMS funds for experiment stations . . . . .	1 440 000
SMITH-LEVER Act . . . . .	1 580 000
MEAT inspection . . . . .	3 000 000
Printing funds . . . . .	600 000

Total . . . \$34 020 000

The Department of Agriculture serves the urban communities in at least two ways. The inspection of all food products that enter into interstate commerce — all food products that are marketed outside the states in which they are grown and prepared for sale — comes under the Department. Many such products cannot be sold unless they bear the stamp of the Department. The urban population also shares, or can share, with the rural population in that part of the extension work which is devoted to home economics; and largely through the activities of the Federation of Women's Clubs, home economics are now being systematically studied by women in the cities. But in normal times no part of the propaganda of the Department is directed to persuading people to leave the cities in order to engage in farming. The object of the Department and of the agricultural colleges and the extension work is the same — to improve all departments of the national economy, to improve conditions on the farms and in the farm homes, and thereby to retain in rural pursuits the men, women and children who are engaged on the six million farms of the United States.

The writer gives the following bibliographical list:

- I. *Historical Sketch of the U. S. Department of Agriculture; Its Objects and Present Organization*, compiled by C. H. GREATHOUSE. Washington, Govt. Printing Office, 1907.
- II. *Hearings before the Committee of Agriculture, House of Representatives, on the Agricultural Appropriation Bill*, 64th Congress, First Session. Washington, Govt. Printing Office, 1915.
- III. *A Brief Statutory History of the United States Department of Agriculture*, by F. G. FRY. Case and Comment, Vol. XXII, Nos 9-10, Feb.-March, 1916.
- IV. *Programme of Work of the United States Department of Agriculture for the Fiscal Year 1917*. Prepared under the Direction of the Secretary of Agriculture by E. H. BRADLEY, et al. 1916. Washington, Govt. Printing Office, 1916.
- V. *Congressional Record*, Vol. LI and LIV. Govt. Printing Office. Washington. 1914-1917.

## CROPS AND CULTIVATION.

- **The Relation of Movement of Water in a Soil to its Hygroscopicity and Initial Moisture** (1). — ALWAY, F. J. (Chief of Division of Soils) and MC DOLE, G. R. (Assistant in Soils, Agricultural Experiment Station of the University of Minnesota), in the *Journal of Agricultural Research*. Vol. X, No. 8, pp. 391-428, XX tables, 2 fig. — bibliography of 17 publications. Washington, August 20, 1917.

A short, historical review of the subject is given. Much work (TROMBARD, VON LIEBENBERG, VON KLENZE, EDLER, WOLLNY, KRAKOW, GREBE, MANN, BRIGGS and LAPHAM, etc.) has been done on the upward movement,

SOIL PHYSICS,  
CHEMISTRY  
AND  
MICROBIOLOGY

(1) See *B.* 1914, No. 308; *R.* 1916, No. 8; *R.* 1917, No. 1114. (*Ed.*)

or capillary rise, of water, and the relation between its rate and distance and the texture of the soil; the results have shown that the finer the texture, the slower is the rise at first, but the greater the final distance reached. On the other hand, up to the present, the downward movement, or infiltration of the water, and the relation of its rate and distance to the texture of the soil has been studied by a few workers only (VON LIEBENBERG, ATTERBERG, WOLLNY, etc.). The results obtained are too discordant to justify definite conclusions, and usually refer only to coarse soils of low hygroscopicity; the relative hygroscopicity of the soils was never taken into consideration. Under natural conditions, in the moist region, the moisture content of the surface foot of soil is rarely as low as the hygroscopic coefficient (1) and, in semi-arid regions, it rarely falls below this value.

The experimental conditions, then, were not in accordance with those found in nature. For this reason the authors undertook new experiments on the upward and downward movement of water, taking into account the hygroscopicity of the soils as expressed by their hygroscopic coefficients and their initial moisture. Seventeen soils, chosen for their different compositions, ranging from coarse sand (hygroscopic coefficient = 0.6), to silt loam (hygroscopic coefficient = 13.3), were placed in three different degrees of moisture, corresponding to 0.5, 1.0 and 1.5 times the hygroscopic coefficient. The first condition corresponds to the lower limit of moisture in exposed surface soils after a prolonged drought during hot weather, the second to the condition found just after the ripening or a very heavy crop during warm, dry weather, the third corresponds to the wilting coefficient (BRIGGS and SCHANTZ) (1).

I. DOWNWARD MOVEMENT IN SOILS OF DIFFERENT INITIAL WATER CONTENT. — *Method*: — To bring the soils to the desired moisture content, air dried material was shovelled over on oilcloth, the calculated amount of water being added meantime. The whole was then passed through a swing sieve again shovelled, then placed immediately in a large, covered can, where it was left for several days. It was then again passed through the sieve, and returned to the can till needed for the experiment, when it was put into glass cylinders 36.2 cm. high and 7.8 cm. in internal diameter. In filling the cylinders, the soil was well pressed down while it was being put in. An inch of water was then added to the surface. To make the initial penetration more uniform, the cylinders were inverted in flat-bottomed trays, the desired amount of water added and allowed to rise into the soil by capillarity, until all, or nearly all, had been absorbed. The cylinders were then placed right side up, covered to prevent evaporation and protected from the sunlight.

The rate of penetration was observed during 5 days, the depth of water being marked in pencil on the cylinders at intervals of 1, 3 and 5 hours. (More than one cylinder was used for each soil as a means of control, but, as the results coincided so well, only the averages are given). At the

(1) For this term, see B. 1912, No. 903. (Ed.)

the period of observation, the soil was removed from the cylinders, the moist part divided equally into three, and the moisture determined.

The results led the authors to the following conclusions, shown in the any tables given.

1) *Relation of the apparent specific gravity and the hygroscopicity.* — Fine-textured soils show a lower apparent specific gravity than the coarser ones, but no direct relation was found between groups of similar texture.

2) *Relation of water retentiveness to maximum water capacity.* — The value of the maximum water capacity is of little significance in the determination of water retentiveness. At the end of 1 hour, the moisture content is only from  $\frac{1}{2}$  to  $\frac{2}{3}$  of the maximum water capacity.

3) *Rapidity of change of moisture content in the moistened layer.* — The moisture content falls more rapidly with finer-textured soils; after 24 hours it is only 2 or 3 times the hygroscopic coefficient, while in coarser soils it rises from 5 to 10 times this coefficient.

4) *Relation of the rapidity with which equilibrium is attained to the hygroscopicity.* — The coarser the soil the more slowly is equilibrium reached; the end of 5 days equilibrium had practically been attained in the finer-textured soils; this was far from the case in the coarser ones.

5) *Relation of hygroscopicity and the initial moisture on the one hand, and rate and depth of penetration on the other.* — The rate of penetration depends little upon the hygroscopicity, but varies very much with the initial moisture, increasing in rapidity with an increased moisture content. The same applies to the depth of penetration, which is not closely related to the hygroscopicity, but depends greatly on the initial content; the depth of penetration increased with the moisture content during the 5 days.

6) *Relation of water content of the moistened layer to initial moisture.* — There is no distinct relationship for the finer-textured soils, but, with the coarser soils, the drier the soil, the wetter is the moistened layer.

It follows that, if rain is preceded by a period of high evaporation, the weather immediately following this rain will have a greater influence upon the loss of moisture by evaporation in the case of a coarse than of a fine-textured soil, as a result of the tardiness with which equilibrium is reached in the coarse soils.

II. UPWARD MOVEMENT IN SOILS OF DIFFERENT INITIAL MOISTURE CONTENT. — *Method:* — The same soils, in the same state of moisture (i.e., 0.5, 1.0, 1.5 times the hygroscopic coefficient), were used as in the previous experiment, and placed in tubes 160 cm. long and 3.0 cm in internal diameter. The soil was well packed, either by jarring the tube while the soil was added through a funnel, or else compressed with a rubber mallet on a wooden rod, passed through the metal funnel connected with the tube. The first method was used for soils the moisture content of which was 0.5 and 1.0 times the hygroscopic coefficient, the second for those 1.5 times the hygroscopic coefficient. The tubes were then placed upright in a rack, the lower end of each dipping into a metal trough and resting on a strip of 0.25 inch mesh wire netting, the object of which was to prevent both the entrance of water and the escape of air. Throughout



the experiment the water in the trough was kept at a depth of 1.5 inches. The experiments with soils of a content equal to 0.5 and 1.0 times the hygroscopic coefficient lasted 10 days, those for the other soils, 8 days. The height of rise was observed at the end of 1, 2, 3, and 24 hours during the first days, and then at the end of each 24 hours. At the end of the period the moisture in the uppermost layer of the moistened portion of the soil column was determined.

The results obtained led to the following conclusions: —

- 1) *Influence of the method of compressing the soil on the capillary rise.* — The jarring and compression methods have no influence on the soils in the driest condition; in the moist soils the compression method seems to retard the rise, at least during the first 24 hours.
- 2) *Relation of hygroscopicity to the rate and height of the rise.* — There is no definite relation; if, at the beginning, the rise is more rapid in soils of low hygroscopicity, this difference gradually disappears.
- 3) *Relation of initial moisture content to the rate and height of the rise.* — No definite relation was seen; in the three moisture conditions studied the rise was generally most rapid in the moistest and slowest in the intermediate.
- 4) *Distribution of moisture in the soil columns.* — All the finer-textured soils show the highest percentage of moisture at the top of the wet layer when used in the driest condition, but the coarser soils show no regularity. In soils other than sands, the moisture content of the wet layer is in close relation to the moisture retentiveness. From this it may be concluded that the wet layer has a moisture content equal to the moisture coefficient, i. e. from 1.7 to 2.5 times the hygroscopic coefficient.

III. — RELATION OF PENETRATION TO CAPILLARY RISE. — If the soil be arranged in order of the rate and depth of penetration and of the capillary rise, the relative positions of the various soils show no similarity. In other words, the relative rates and differences of penetration in the different soils are not similar to the relative rates and heights of capillary rise (this lack of similarity was shown by VON LIEBENBERG in his studies on dry soils).

Some of the soils used contained 3 and 4 times as much organic matter as the others. No characteristic relation was observed between the variation in organic matter and the rate and height of penetration; but the organic matter increased the capillary rise after the first day and the height attained in all the three moisture conditions studied.

129 - Further Studies on the Nitric Nitrogen Content of the Country Rock. — STEWART R. and PETERSON, W., in *Utah Agricultural College Experiment Station, Bulletin No. 15*, pp. 20, 1 fig., VII tables. Logan, Utah, May, 1917.

Certain soils in western America contain spots very rich in nitric nitrogen, having often a nitric nitrogen content several hundred times higher than that of normal cultivated, irrigated soil. These are locally known as "nitre spots". Two theories have been expressed with regard to the origin of these accumulations: — 1) that of HILGARD, who attributed it to the more rapid nitrification of the organic matter of the soil in arid climates.

that of HEADDEN and SACKETT, who attributed it to the fixation of the atmospheric nitrogen by non-symbiotic bacteria.

Experiments made during 10 years by the authors on the influence of irrigation water on the production and movement of nitrates in irrigated soils, led them to form an entirely different opinion as to the origin of these nitre spots. They consider them to result from the leaching of the nitrates out of the pre-existing deposits in the rock and their local concentration by seepage water.

Two facts contributed to the formation of this opinion: — 1) it was found that nitrification is not appreciably more rapid in arid soil than in mid soil when measured by the nitrates present in the soil at various depths, in definite seasons and from year to year; 2) all the data supplied by HILGARD and HEADDEN on nitre spots, always mention additional amounts of other alkali salts.

Previous work had already shown that rock adjacent to the affected areas which had contributed to the soil formation, was impregnated with alkali salts, including nitrates, and in sufficient abundance to account for the accumulations noted. The investigations were continued with respect to various soils belonging to three geological formations — jurassic, cretaceous and tertiary. All cretaceous soils were found to contain nitrate. Tertiary soils contain slightly less, although it is in them that are found the greatest number of nitre spots. Jurassic formations have a much lower nitrate content (See Table I).

Analyses were made of soils from different parts of Utah, belonging not only to the cretaceous, tertiary and jurassic systems, but also to the triassic, permian and pennsylvanian. This proves that the formation of nitre spots is not limited to the rocks of any given geological system. The analytical method used was as follows: — 100 gm. of finely-ground rock were placed in a large flask with 1000 cc. of distilled water and shaken in a shaking machine for 16 hours. The solution was then filtered through a CHAMBERLAIN-PASTEUR filter, and the nitric nitrogen determined by the luminium reduction method (1).

Table II gives the results found for the different districts, characterized, consequently, by a high total content of soluble salts. With two exceptions, however, the nitrate content is not 1 % of the total content.

The nitrate is carried from the original rock by seepage water, and more rapidly where the water escapes from leaking irrigation canals which cut through the shale strata at some high point, thus allowing the seepage water to follow the shale strata to the point of outcrop, where the evaporation of the water produces a nitre spot. In cultivated soils the accumulation of nitrates is only found where the conditions allow the free movement of seepage water. Nitre spots may reach such a degree of concentration as to make growth impossible, both in cultivated and in virgin soil. Their characteristics are: 1) a high nitrate content; 2) the presence of large quantities of other soluble salts (chlorides and sulphates); 3) brownish colour; 4) thin

(1) See B. 1914, No. 206. (Ed.)

crust over the surface ; 5) mealy or ash-like condition under the hard crust ; 6) beneath this material is the soil, made moist, sticky and glistening by the continual presence of calcium chloride, which is known to be very deliquescent.

In rocks, as in soils, the nitrates are not independent of other allied salts, and no case is known where nitrates only have been found ; sulphates and chlorides especially occur in large quantities. The content of nitre spots in nitrate, as well as in other salts, is very variable.

The characteristic brown colour is not due to the nitrates, which are colourless, but to their solvent and decomposing action on the coloured organic compounds of the soil. The non-symbiotic bacteria are essential neither to the formation of the colour nor to that of the nitrates, their presence being purely incidental ; this is proved by the fact that nitrogen fixation by these bacteria is greater in dry-farm soils, where no nitre spots are found. Investigations have shown that the maximum fixation is 15.8 mg. of nitrogen (SACKETT) per 100 gm. of nitre spot soil, whereas, in dry-farm soil, the maximum is 51.8 mg. of nitrogen (GREAVES).

The authors reproduced nitre spots artificially in the laboratory : 300 gm. of rich greenhouse soil were treated with an excess of sodium nitrate solution (10 %), and dried slowly in the sun. The dry soil had all the characteristics of the nitre spots, which it retained when treated with a saturated solution of mercuric chloride or a 5 % solution of carbolic acid, *i. e.* when the soil was sterilised, thus definitely eliminating the action of non-symbiotic bacteria.

TABLE I. — *Percentage of sodium nitrate in various soils.*

	Maximum .	Minimum	Average
<i>Tertiary soils :</i>			
Sandstone . . . . .	0.284	None	0.074
Shale . . . . .	0.750	None	0.147
Clay . . . . .	0.940	None	0.053
Ash . . . . .	3.280	0.0002	0.236
Alkali . . . . .	0.232	None	0.021
<i>Cretaceous soils :</i>			
Sandstone . . . . .	0.293	0.005	0.055
Shale . . . . .	1.026	0.003	0.104
Clay . . . . .	0.115	0.002	0.039
Ash . . . . .	3.270	0.005	0.870
Alkali . . . . .	3.350	0.003	0.074
<i>Jurassic soils :</i>			
Sandstone . . . . .	0.039	None	0.008
Shale . . . . .	0.019	None	0.005
Ash . . . . .	0.202	0.149	0.175
Alkali . . . . .	0.017	0.017	0.017

TABLE II — Soluble salts and nitric nitrogen in various soils.

District	Total soluble salts per million	Nitric nitrogen	
		parts per million	per cent of total salts
th of St George, Utah . . . . .	29 989	81.4	0.71
t of " " . . . . .	48 962	156.0	4.22
t of " " . . . . .	54 256	74.31	0.79
thern Arizona . . . . .	51 858	27.3	0.212
nity of Mt Carmel, Utah . . . . .	17 734	67.7	1.07
nity of Cedar City, " . . . . .	36 055	28.7	0.16

— Absorption and Other Modifications of Certain Fertilising or Anti-cryptogamic Compounds in Various Natural and Artificial Soils. — DE WILKOSZEWSKI, BOGUMIL, *Archives des Sciences physiques et naturelles*, Vol. XLIV, No. 9, pp. 165-189; No. 10, pp. 256-275, 2 figs., 6 tables, bibliography of 23 publications. Geneva, 1917.

The author studied the absorption and other modifications undergone ferrous and ferric sulphate; manganese sulphate, copper sulphate, calcium cyanamide, during their passage through natural and artificial soils, through the physical constituents of the latter. The soils used were: —

Loamy soils containing 0.38 % and 0.9 % of lime respectively.

"Angers soil", derived from the disintegration of schists, free from lime.

Loam freed from lime by repeated washing with hydrochloric acid.

Artificial soils and their constituents — Fontainebleau quartz sand, kaolin, pure calcium carbonate, heath soil composed entirely of mus without lime.

The soils, placed in glass dropping funnels 40 cm. high and 2 cm. in meter, were gradually watered with solutions of the substances studied, estimations were made of the liquid from the infiltration from time to time so as to keep count of the modifications which took place during the passage of the solutions through the soils.

The principal results may be summarised thus: —

FERROUS AND FERRIC SULPHATES. — The iron of the latter is more easily absorbed by the soil than the iron of the former, which, moreover, found in the soil in the ferric state. This proves that ferrous iron is reduced by the soil only after it has been oxidised, by hydrolysis, to ferric state; it is even possible that the free acid acts partly on the hydrate and gives an insoluble basic salt which cannot be removed from the soil. This hydrolysis is greatly favoured by the presence of the soil particles. Calcareous soils retain the iron. Clay soils absorb ferric sulphate to a large extent, but ferrous sulphate only slightly, because oxidation takes place with difficulty.

MANGANESE SULPHATE. — After the solution has filtered through the soil it contains manganese oxides, perhaps even manganese peroxide; the catalytic action of manganese used as fertiliser is probably due to this phenomenon.

**COPPER SULPHATE.** — In the experiments with this salt the  $\text{Cu}^{++}$  was retained in the form of a hydrate, or perhaps in the form of an insoluble basic salt, for the  $\text{SO}_4$  ion is found in the filtration liquid.

In a general way it may be concluded that it is not the salts themselves which are retained by the soils, for they are hydrolysed, their base is rendered insoluble and the acid ion passes into the drainage water.

**CALCIUM CYANAMIDE.** — This is now known to change in the soil to urea, ammonium carbonate, nitrites and nitrates. The author further proved that when calcium cyanamide solution filters through the soil the change into urea and ammonium carbonate is much more marked than when solid cyanamide is dug in.

According to the author these changes are not due to bacterial action but to the capacity of the soil to facilitate the fixation of water, thus causing hydrolysis. This is proved by the fact that the transformation occurs immediately, both in arable and *sterilised* soil. Oxidation is favoured by soils of a spongy structure, such as infusorial soil, which has an obvious catalysing action, and where the nitrification of the cyanamide, urea or ammonium carbonate reaches its maximum. The production of nitrite was about 20 times greater in these soils than in ordinary ones.

Special attention should be given to the nitrification of the cyanamide in the soil in the absence of all organisms. The conditions under which the change takes place are not clear, and the author proposes to study them. During his studies he observed that Nessler's reagent does not form a precipitate with the ammonium ion in the presence of calcium cyanamide.

131 — **Relation of the Transformation and Distribution of Soil Nitrogen to the Nutrition of Citrus Plants.** — See No. 173 of this Review.

132 — **Vegetation on Swamps and Marshes as an Indicator of the Quality of Peat Soil for Cultivation.** — DUNNEWALD, T. J., in the *Journal of the American Society of Agronomy*, Vol. IX, No. 7, pp. 322-324. Washington, October 22, 1917.

Most workers have concluded that the surface vegetation on peat gives no clue to the relative quality of the soil for the purposes of cultivation. On the other hand, farmers and drainage men often assert that peat on black spruce (*Abies nigra*) or moss covered swamp is no good for cropping whereas good black muck with elm or ash on it is the best kind of land to drain.

Under the drainage law of the State of Wisconsin, the author, a member of the staff of the Wisconsin Agricultural Experiment Station, examined an area of about 6 600 acres of scattered marshes and swamps. The upland is non-calcareous glacial drift, derived from granitic and sandstone rock with no limestone in the vicinity. The author wished to discover whether a favourable or unfavourable chemical condition would be found in different areas of the peat, and whether the vegetation would give any indication of such conditions.

A field study showed that spruce (*Abies nigra*) and tamarack (*Larix americana*) peat areas were the wettest, with the water table practically at the surface of the soil, and a covering of 12 to 18 inches of spongy moss. The depth of the peat or distance from the shore seemed to have little effect.

on the kind of surface growth, and the degree of decomposition of the peat has hardly more effect.

Table I summarises the more important determinations made in the laboratory. All the samples, except No. 7, were taken from a depth of 6 to 20 feet. Samples 1 and 2 were taken from different parts of the same swamp. Fine sand grains were found in Nos. 7 and 10 and not included in the average loss on ignition. The data show that peat bearing black spruce and tamarack has 20 % less mineral matter, a much higher degree of acidity, and somewhat less nitrogen.

The greater acidity of spruce and tamarack peats may be due to the more continual flooded conditions of these swamps, and drainage experience shows that this acidity often disappears largely after the peat has been drained and cultivated. The author considers his experiments confirm the farmer's statement that trees, such as ash, elm, birch and white pine (*Pinus Strobus*) show a better quality peat than that on which grow only black spruce, tamarack, sphagnum moss, blueberries and cassandra (*Cassandra alcyonata*).

Determinations of the solubility of the peats in 150 cc. of a 2 % caustic soda solution, showed acid peats to be from 3 to 8 % more soluble than the less acid ones, but, if an amount of the solvent sufficient to counteract the extra acidity of the spruce peats be used, the difference in solubility is not noticeable.

*Comparative determinations of the organic matter, acidity and nitrogen in peat soils in the same district bearing different classes of vegetation.*

Number of soil	Vegetation	Loss on ignition %	Total acidity	Total nitrogen
2	Tamarack ( <i>Larix americana</i> ) . . . . .	78.56 %	very strong	1.58 %
4	Tamarack ( <i>Larix americana</i> ) and moss.	79.11	strong	1.95
	Average . . .	78.80 %	strong	1.78 %
5	Black spruce ( <i>Abies nigra</i> ) and moss . .	85.48 %	very strong	1.86 %
8	Black spruce ( <i>Abies nigra</i> ) and moss . .	91.07	very strong	1.86
9	Black spruce ( <i>Abies nigra</i> ) and moss . .	90.89	very strong	1.90
11	Black spruce ( <i>Abies nigra</i> ) and moss . .	88.14	very strong	1.69
14	Black spruce ( <i>Abies nigra</i> ) and moss . .	93.01	very strong	1.82
	Average . . .	88.90 %	very strong	1.81 %
1	Mixed ash, birch and balsam ( <i>Abies balsamea</i> ) . . . . .	60.61 %	very slight	1.06 %
3	Large ash ( <i>Fraxinus americana</i> ), birch, poplar and cedar . . . . .	81.01	slight	2.17
6	Birch, ash, elm . . . . .	60.91	medium	2.02
7	Mixed birch, ash, tamarack ( <i>Larix americana</i> ), willow . . . . .	56.85	slight	—
10	Ash, birch, a few large tamarack ( <i>Larix americana</i> ) and pine . . . . .	47.14	medium	—
17	Elm, ash, cedar and grass . . . . .	62.08	medium	2.20
	Average . . .	61.60 %	slight	2.09 %

133 - **Practical Information for Beginners in Irrigation.** — FORTIER, SAMUEL, in U. S. Department of Agriculture, *Farmers' Bulletin* No. 864, pp. 38, 23 figs, 2 tables. Washington, September, 1917.

The U. S. Department of Agriculture has just published a revised edition of the *Farmers' Bulletin* No. 263, originally published on July 31st., 1906. It contains practical information for farmers who wish to settle in the center and west of the United States where irrigation is essential. Besides general considerations on arid soils and water supplies for irrigation, the bulletin contains practical advice on selecting a farm under an irrigation system and more detailed descriptions of the location and construction of farm ditches, the preparation of the land to be irrigated, the irrigation of a few of the staple crops (alfalfa, grain, potatoes, fruit trees and small fruits and vegetables), and the amount of water to be used.

Canal companies supply water to farmers by contract. Up to a few years ago the prevailing type of contract was one providing for the sale of a perpetual water right for a given tract of land, with an additional annual charge for the operation and maintenance of the canal system. This type is not usual now, the most common being the sale, with the land to be irrigated, of rights which carry an interest in the works supplying water, so that they become the property of the landowners when a fixed portion of the rights have been paid for. The cost of building the works is not included in the purchase price of the land, but is levied in the form of taxes.

The quantity of water to be supplied by the companies is fixed by contract. The most usual is a stream of given size, say 1 cubic foot per second for each 80 acres of land to be irrigated. Others agree to supply enough to cover the land to a given depth, say 2 feet, during each season.

Irrigation water may also be obtained from the Government at a stipulated price per acre. In this case the water is supplied to private landowners through a water users' association, in which all the landowners within the project become shareholders. The cost of a water right under a Government project varies from \$25 to \$29 per acre, and is payable in 25 annual instalments. When the payments for the water for the major portion of the land have been made, the operation and management of the irrigation system, exclusive of all storage reservoirs, passes to the owners of the land irrigated, to be maintained and operated at their expense.

After having discussed the construction of farm ditches, undertaken by the farmers themselves, the author gives the customary measurements of ditches, and, in a series of figures, gives the sections for specified ditches. The water is controlled by means of division boxes, made usually, and most economically, of wood. Stress is laid on the necessity of avoiding useless loss of water, either by faulty preparation of the soil, by carelessness, or lack of supervision in the distribution of the water. Experience shows that the great danger in irrigation, in all the arid districts of the United States, arises from the lack of efficient drainage of the soil. Where the natural drainage is insufficient, the salts from the sub-soil accumulate on the surface and soon make all cultivation impossible. It is, therefore, under such conditions, essential to have recourse to artificial drainage, which is almost as expensive to instal as a water supply.

4 - Irrigation of Semiarid Soils by means of Wind Engines, in U. S. A. — See No. 207 of this Review.

5 - Citrus Irrigation in California, U. S. A. — See No. 173 of this Review.

6 - The Value of Coconut Poonac as Manure. — BAMBER, M. K., in *Department of Agriculture, Ceylon, Leaflet No. 1*, p. 1, Ceylon, 1917.

Owing to the difficulty of freight and consequent lower demand, the use of coconut poonac (native coprah cake) in Ceylon has fallen considerably, and the question of its use as a manure instead of a food has arisen. Analysis showed it to contain the following percentages of manurial elements: —

Nitrogen . . . . .	3.33 %
Phosphoric acid . . . . .	1.47
Potash . . . . .	1.29
Lime . . . . .	0.90
Soda (as salt) . . . . .	1.17

If coconut poonac is compared with other cakes now used as manure it is seen that, for the same quantity of nitrogen: —

to 100 lbs. groundnut cake correspond 210 lbs. coconut poonac.	
“ “ castor cake No. 1 “ 150 “	—
“ “ “ “ No. 2 “ 135 “	“
“ “ rape cake “ 120 “	“

For this reason, in spite of its high food value, and considering that it liable to become rancid on keeping unless very thoroughly dried, it is advisable, under present conditions, to use poonac as a manure in the country producing it.

7 - Saltpetre: Its Origin and Extraction in India. — HERCINSON, C. M. (Imperial Agricultural Bacteriologist), in *Agricultural Research Institute, Pusa, Bulletin No. 68*, 1916, pp. 24 + IV plates. Calcutta, 1917.

The author has made a new study of the saltpetre industry in India(1) and shows that, under favourable conditions, the prospects for an increased production of Indian saltpetre are very promising. The present sources are not fully worked on account of the primitive native methods and low price of crude saltpetre. In view of the favourable soil and climatic conditions in Bihar, artificial nitre-beds would probably form a useful added source of saltpetre. The present methods do not allow all the nitrate present in the earth to be extracted.

It is, therefore, necessary to devise a new, practical method of extraction, and to see whether the efficiency of the method would depend upon a relaxation or revision of the restrictions imposed by the Salt Department. The present conditions of the saltpetre trade also demands examination to determine whether a greater demand would result from organised efforts to improve these conditions by eliminating the middleman and standardising the product itself.

(1) See *B.* 1912, No. 57; see also INT. INST. OF AGRIC., *World's production and consumption of chemical fertilisers*, 2nd. edition, 1911. — *World's production of fertilisers and of chemical substances for agricultural use.* (Ed.).



138 - **Inventory of Seeds and Plants Imported by the Office of Foreign Seed and Plant Introduction During the Period from April 1 to June 30, 1914** (1). — U. S. Department of Agriculture, Bureau of Plant Industry, Inventory No. 39, pp. 183 + X plates. Washington, 1917.

This inventory describes or lists 109 recently imported plants, many of which were acquired by exchange with official institutions or private exporters. Among the most important may be mentioned: —

**CEREALS.** — The two principal rice varieties of Tarragona, Spain (Nos. 37696 and 37697); a collection of South African wheats (Nos. 38601 to 38631), including the best Boer varieties adapted to the poor, unmanured lands of that district; 11 varieties of wheat (Nos. 38343 to 38353) have been developed by the wheat breeders of the Department of Agriculture of New South Wales and are considered worthy of trial in the south-west of the United States; a selected Danish 2-rowed barley (No. 37701) and a 6-rowed variety (No. 37707), showing peculiar resistance to smut (*Ustilago Hordei* and *U. nuda*) and leaf-spot (*Septoria graminum*), are a good quality, yellow spring oat (No. 37708), selected by the Royal Danish Agricultural Society of Copenhagen; the dwarf Black Grushers sorghum (No. 37733) from the farm of the Grand Duke Nicholas in the Ekaterinoslav Province of Russia, which is distinguished by early maturity, even in very cold summers, and is the best yielder of 20 varieties tested there; a variety of maize (No. 38544) grown by the Panetes Indians of the Upp Gy Parana (Machabo) River of Brazil.

**FORAGE CROPS.** — The most remarkable is *Merremia hederacea* (No. 38647), a creeping plant of the convolvulus family from the Island of Guam; stock prefer it to any of the other forage plants of the island and it may be grazed all the year round; 59 wild or cultivated forage grasses from Brazil (Nos. 37983 to 38041); the Apitrefle, or bee clover (No. 37937) from Prof. G. MARTINET of Lausanne, Switzerland, a variety of red clover with shortened, more open flowers, which enable the bees to collect the honey with greater ease; 2 annual species of clover from Budapest, *Trifolium angulatum* and *T. parviflorum* (Nos. 37681 and 37682), which remain dwarf in dry years, serving as pasturage, but grow high enough for hay in wet spots or in wet years; a wild type of Kentish white clover (*Trifolium repens*) (No. 38579), which experiments at Armstrong College, Cockle Park, England have shown to be superior to Dutch clover (2); many hardy varieties of sugar cane (Nos. 38257 and 38332), from Chengchow and Kaifeng, in Honan Province, which might be grown above the natural cane belt in the South of the United States and be useful for fodder, if not for syrup production; a very early-ripening Italian rye-grass (*Lolium multiflorum*) (No. 37709) a meadow fescue (*Festuca elatior*) (No. 37710), very resistant to rust (*Puccinia*) and an orchard-grass (*Dactylis glomerata* sub-variety "Olsgaard" (No. 37711) all selected by the Royal Agricultural Society of Denmark; the Jua tree (*Ziziphus joazeiro*) (No. 37923) from Joazeiro, Brazil, the fruit and leaves of which are used as food for stock.

(1) See R. Dec. 1917, No. 1129 (Ed.) — (2) See R. Sept. 1917, No. 814. (Ed.)

**FIBRE PLANTS.** — Caroa (*Neoglaziovia variegata*) from Joazeiro (No. 37 705), a wild Bromeliaceae growing on the São Francisco River, used by the native for ropes; the piassava palm (*Attalea funifera*) from Bahia (No. 37 868), from the fibre of which excellent brooms and brushes are made, while buttons are manufactured from the hard nuts.

**OIL-YIELDING PLANTS.** — Ngart (*Plukenetia conophora*) (No. 38 644), creeping Euphorbiaceae, cultivated throughout the Ossidinge district (ameroons). The thin-shelled nut contains a hard oily kernel. Experiments have shown that neither the kernel nor the oil contain harmful substances. The kernels, without the shells, weigh 4 or 5 grams and give 53.8 % of drying oil, resembling linseed oil, and used by the natives. The fatty acid contains 45.6 % of protein.

The characteristics of ngart oil are: —

Specific weight at 17.5°C.	—0.934
Congealing point	— 33°C
Iodine number of the oil	177.3
Iodine number of the free fatty acids	187.4
Saponification number	192
Refractive index at 17.5° C.	—1.4830

(KRAUSE and DIESSMORST, *Tropenpflanzer*, Vol. XIII, p. 282, 1909).

From the leaves of the carnauba wax palm (*Copernicia cerifera*) (No. 37 866), imported from Joazeiro, is obtained a wax that was formerly used for phonograph records. Its fruit is an excellent food for pigs, and should not be impossible to plant groves of these palms for hog pasturage.

**GUM PLANTS.** — The true gum-arabic acacia (*Acacia verek*) (No. 38 524), from Khartoum, may be capable of acclimatisation in the south-western district of the United States.

**DRINK-YIELDING PLANTS.** — Chici (*Salvia* sp.) (No. 38 048), from Zapopan, Huatusco, Vera Cruz, Mexico; the seeds are put in water, where they swell and soften, mixed with sugar and red wine, and used as a drink; or Kava (*Piper methysticum* (No. 38 291), from Pago Pago, American Samoa, used as a drink.

**VEGETABLES.** — Many interesting species have been imported. A new variety of roselle (*Hibiscus sabdariffa*) (No. 37 698), called "Temprano", raised at the Lamoa Experiment Station, Philippine Islands, is a sport from the "Victor" variety, ripening 20 days earlier; it may be grown for much further north than the Victor can be grown; a cucumber (No. 37 700) introduced into the Philippines from Seharunpur, India, has shown resistance to insect attack and is proving one of the best varieties for cultivation in the tropics; a hybrid between thousand headed kale and kohlrabi, obtained from E. WEBB and SONS, Wordsley, England; it has a thickened stem growing erect high, which is suitable for forage during the winter; a Chinese ginger (*Zingiber officinale*) (No. 38 180) from Feichang, Shantung, the candied rhizomes of which are shipped in large quantities to the United States; 5 varieties (Nos. 38 356 to 38 360) of the very best starch, table and feeding potatoes of Polish origin, produced by M. HENRY DOTOWSKI; the New Era potato (No. 37 947), said not to be affected by potato blight (*Phytoph-*

*thora infestans*), has been obtained from New Zealand; a variety of the yam-pee yam (*Dioscorea alata*) (No. 37 943), produced at Avon Park, Fla., deserves serious study as it does well in very light sandy and rocky soil where potatoes will not grow; from Coban, Guatemala, have been imported seeds of the pacaya salad palm (*Chamaedorea* sp.) (Nos. 38 403 and 38 404) which, after 3 or 4 years, produces from 4 to 6 fleshy inflorescences about the size of ears of maize which, when cooked, make a delicate salad; it is believed that this species will grow in southern Florida.

FRUIT TREES. — Galo (*Anacolosia luzoniensis*) (No. 38 395), from the mountains of Cavite (Philippines) with a kernel having the flavour of maize; K'uei li tzu (No. 37 799) a superior large-fruited form of the blight-resistant Chinese chestnut (*Castanea mollissima*), introduced from Sianfu, Shansi; 24 new varieties of oriental persimmon (*Diospyros Kaki*), 11 of which come from Tongjapu (Nos. 37 648 to 37 658), including an especially valuable variety for drying purposes; an improved variety of *Diospyros kaki* (No. 37 811) used for stocks in the loess table-lands, which are very dry and alkaline; 5 new forms of persimmon from Shansi province (Nos. 37 660 to 37 665); the salt-bag persimmon and honey-pot persimmon (Nos. 37 666 and 37 678), the latter a prolific and showy bearer of fruit no larger than cherry; both were imported from Shansi; 5 varieties from Shantung (Nos. 37 948 to 37 952), one of which is eaten pickled in brine; a staminate variety (No. 38 482), found in Bermuda, valuable as a polleniser. The importance of finding a pear resistant to blight (*Bacillus amylovorus*) induced Mr. MEYER to continue his search for a better flavoured melting Chinese pear from Shansi, Honan and Shantung he sent 15 varieties of more or less promise for breeding purposes (Nos. 38 240, to 38 242, 38 262 to 38 271, 38 272 and 38 278); the Rev. HUGH W. WHITE sent from Yencheng, Kiangsu, the Tangshan pear (No. 37 982), the only sweet, juicy pear with a woody taste he has seen; an apricot variety (No. 37 744) from the Dakhleh Oasis of Egypt capable of resisting an annual temperature of 75° and monthly averages 90° F.; from Shansi were received 14 varieties of Chinese jujube (*Ziziphus Jujuba*) (Nos. 38 243 to 38 247, 38 249 to 38 253 and 38 258 to 38 260), some with fruit as large, or larger, than hens' eggs, being more like small pears; they may be eaten fresh, cooked in various ways or preserved with honey, sugar, etc.; a variety of Chinese haw (*Crataegus pinnatifida*) (No. 38 176), the red-fleshed, large fruit of which will keep several months; the Fei peach (No. 38 178), considered the best in China on account of its size, lateness (middle of October), good shipping qualities and aromatic flavour; from Rio de Janeiro and Bahia, Brazil, came scions from 24 new oranges, selected on account of their high yield, uniformity of fruit, sweetness, vigour, absence of spines and tendency to bear throughout the year; the Selecta orange (Nos. 37 796 and 37 840 to 37 842); the pear orange (Nos. 37 797 and 37 843); the bitter orange, laranja da terra (No. 37 775); the seedy sweet orange, laranja da china (No. 37 776); the last two are used as stocks for the navel orange; the lime orange (No. 37 784), with a flavour intermediate to that of the orange and the lime; a much esteemed orange

is made from it (a typical fruit weighs 350 grams and gives 125 cc. juice).

A Nakon Chaisri seedless Siamese pummelo (No. 37 724) from Bangkok; the alamoen from Surinam (No. 37 804), a superior variety of grapefruit; the desert kumquat (*Eremocitrus glauca*) (No. 37 712) and *Atalantia mo-phylla* (No. 38 511), from India and Ceylon; from Cavite province, *Eupho-ri cinerea* (No. 38 374), a remarkably sweet Sapindaceae; from Coban, varieties (Nos. 38 478 to 38 481) of injerto (*Acradelphe viridis*); from Guatemala, the pitaya (*Cereus triangularis*) (No. 38 601), a pleasant flavour-ful, deep-purple fruit produced by an epiphytic *Cereus*; from Cuba, rare species of *Anacardium excelsum* (No. 38 209); from Rio de Janeiro the "fruta e condosa" (*Rollinia deliciosa*) (No. 38 171); the guahiroba (*Campomanesia ndiana*) (No. 37 834), whose fruit is highly esteemed for jellies; "cambuhy a India" (*Eugenia campestris*) (No. 37 830), "cereja do Rio Grande" *E. edulis* (No. 37 831), *E. speciosa* (No. 37 832); *Rheedia brasiliensis* (No. 38 02) from Rio de Janeiro; from Januaria, the imbu (*Spondias tuberosa*) (Nos. 37 861 to 37 865), one of the most popular fruits of the interior of Bra- zil. To the collection of subtropical fruit have been added 24 choice varie- ties of hard-shelled avocados (*Persea americana*) (Nos. 38 477, 38 549 to 38 564, 38 578, 38 581, 38 583, 38 587 and 38 638 to 38 640) from the district of Coban, Antigua and the city of Guatemala, some at an altitude of 5000 ft.; their fruit ripens late (winter and spring) and is of good quality.

59 - The Effect of Different Rotation Systems and of Fertilizers on the Protein Content of Oats. — THATCHER, R. W. and ARNY, A. C., in the *Journal of the American Society of Agronomy*, Vol. IX, No. 7, p. 344-348. Washington, D. C., October 22, 1917.

The experiments described were carried out at the Minnesota Agricultural Experiment Station.

Work on the influence of various fertilisers on the composition of oat grains has already been published (1), but it has rarely been carried out over more than one season, and the results are often inconclusive.

(1) Woods, C. D. (Effects of Different Fertilizers upon the Composition of Oats and Straw, *Connecticut State Agricultural Experiment Station Report* for 1892, pp. 47-56), found an apparent increase in protein content of both straw and grain in proportion to the quantity of nitrogen applied in the fertilizer.

WEINULL, M. (Cooperative Fertilizer Experiments in Malmöhus County, Sweden, 1902; abstract in the *Experiment Station Record*, Vol. XV, p. 570, 1903), using the composition of the top as an index for the fertilizer requirement of the soil, concluded that, since there was a slightly increased percentage of nitrogen in the grain and of potash in the straw from plots fertilised with these elements, and no consistent increase of phosphoric acid in grain from plots treated with phosphate fertilisers, the soils were in need of nitrogen and potassium, but not of phosphorus.

PINGREE, M. H. (The Influence of Nitrogenous, Phosphatic and Potassic Fertilisers upon the Percentage of Nitrogen and Mineral Constituents of the Oat Plant, *Pennsylvania Agricultural Experiment Station Report*, 1906, pp. 43-53), as a result of studies on oats in 1904, found that when nitrogen was applied alone there was a larger proportion of protein in the dry matter of the whole plant than when any other fertilizer was used. The proportion of protein was distinctly less on the unfertilised plot, still lower when potassium alone was used, and lowest of all when phosphoric acid was applied, even in a complete fertilizer.

In the studies described the samples analysed were taken from soil in which there was regular rotation, and, consequently, from different plots each season. The possibility of the effects being due to soil differences or to accumulations from previous soil treatments was thus reduced to a minimum. The same variety of oats was used in all the experiments; the rate and date of sowing, method of harvesting, etc., were identical each year. The methods of rotation and fertilisation were as follows:

**ROTATION PLOTS.** — *Continuous Oats*. — This plot was sown with oats each spring from 1909 onwards. Manure was applied at the rate of 6 tons per acre in the autumn of every third year; the last application was in 1913.

*Two-year rotation; oats and wheat or oats and maize*. — The method was the same as the continuous oats.

*Three-year rotation; no manure, maize, oats and clover. Model rotation*. — The same treatment as in the previous case, except that, for Model rotation, manure was applied in autumn before the planting of maize at the rate of 6 tons per acre.

*Four year rotation: maize, oats, wheat, clover*. — In the autumn preceding the maize, 8 tons per acre of manure were applied.

*Five-year rotation: maize, oats, wheat, clover, timothy hay*. — In the autumn preceding the maize, 10 tons per acre of manure were applied.

**FERTILISER PLOTS.** — On all these plots there was a three-year rotation of maize, oats and clover. The fertilisers were applied annually, each one separately. The phosphates and potash were applied at sowing time, the nitrate after the grain and maize were up. The kinds and quantities used were as follows:

*Commercial fertiliser only*. — When the seed bed was prepared 250 lbs. of acid phosphate and 100 lbs. of muriate of potash per acre were applied, half to the oats and half to the

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TRETIKOW, S. S. F. (Influence of Mode of Cultivation on the Chemical Composition of Cereals; Abstract in *Experiment Station Record*, Vol. XXXIV, p. 230, 1916), found that barnyard manure increased the protein content of oats from 11.38 to 12.81 %.

LIPMAN, J. G. (The Associative Growth of Legumes and Non-legumes, *New Jersey Agricultural Experiment Station, Bulletin* 253, 1912), studied the effect of potassium sulphate and sodium nitrate on oats grown alone and with peas, in large galvanised iron cylinders in the field and in pots in the greenhouse, and on other legume and non-legume combinations. He concluded that:

1) Under favourable conditions non-legumes associated with legumes may secure large amounts of nitrogen from them, even though this may not be shown by an increased proportion of nitrogen in the dry matter of the non-legume; 2) when sodium nitrate is applied to such crop mixtures, the non-legumes gain an advantage in the competition for moisture, light and plant-food, and the growth of the legume suffers. The legume contains not only less dry matter and nitrogen, but may also contain a smaller proportion of nitrogen in the dry matter.

LYON, T. L. and BIZZELL, J. A. (A Heretofore Annotated Benefit from the Growth of Legumes, *New York (Cornell) Agricultural Experiment Station, Bulletin* 294, 1911), noted an increased protein content in timothy when grown with alfalfa or clover, and of oats when grown with peas, as compared with that of the grass or cereal when grown alone on adjacent plots in the same season.

None of these studies deal with the effect of a legume in the rotation upon the protein content of the crops grown in the intervening years, and the work described in the paper under review seems to be the first on this subject.

After the grain was up 300 lbs. per acre of nitrate of soda were applied, half to each crop *manure and commercial fertiliser*. — Manure at the rate of 6 tons per acre; commercial fertiliser as in the previous case.

*Manure and nitrate of soda*. — Each year 6 tons of manure per acre were applied to the oats, and, in addition, 320 lbs. per acre of nitrate of soda, half to the oats and half to the maize.

*Manure and muriate of potash*. — Each year 6 tons per acre of manure were applied to the oats, and, in addition, 200 lbs. of muriate of potash per acre, half to the oats and half to the maize.

*Manure and raw rock phosphate*. — Each year 6 tons of manure and 1 000 lbs. of raw rock phosphate per acre were applied to the maize.

*Manure and acid phosphate*. — Six tons of manure per acre were given to the maize, and, in addition, 400 lbs. of acid phosphate per acre, half to the oats and half to the maize.

Tables I and II, which give the results of the analyses of the oats from various plots, show a definite effect of the rotation system on the chemical composition of the crop. Short rotations without clover or an unfilled crop requiring summer cultivation of the land, always gave oats a low protein percentage. The three-year rotation with clover, with or without manure, and with at least one maize crop to provide summer cultivation, gave, without exception, oats of medium protein content. Longer rotations, with clover, or with clover and pasture, yielded oats of high protein content.

TABLE I. — *Effect of different rotation systems upon the protein content of oats, expressed as percentage of protein in the dry matter.*

Rotation	Manure per acre	Percentage of protein in dry matter			
		1914	1915	1916	Average
maize oats . . . .	6 tons each 3rd. year . .	12.94	11.96	13.02	12.64
oats and wheat . .	do. . . . .	12.63	12.17	12.73	12.51
oats and maize . .	do. . . . .	13.25	11.95	13.13	12.78
oats, clover, maize	None (control) . . . .	14.00	14.66	15.46	14.71
oats, clover, maize	6 tons preceding maize .	14.63	13.45	14.92	14.33
oats, wheat, clover, maize	15.25	15.73	14.89	15.29	
oats . . . . .	8 tons . . . . .				
oats, wheat, clover, pasture	15.88	14.49	15.05	15.14	
oats, maize, oats . .	10 tons . . . . .				

Table II shows a definite correlation between the protein content of oat grain and the fertiliser treatment. Plots receiving nitrogenous fertilisers invariably produced grain with a higher protein content than plots receiving any other treatment. The single sample having the highest percentage of protein and the highest average for the four-year period was obtained with the use of nitrate of soda. The complete fertiliser contained enough readily available nitrogen to produce nearly the same effect upon the composition of the oats as the sodium nitrate alone. The potash fertiliser

produced oats with a slightly lower protein content than those from the control plots in every one of the four years. The phosphate fertilisers did not materially change the protein content of the grain, which was sometimes a little higher, sometimes a little lower, than that from the control plots. The average protein content was practically identical in the control, rock phosphate and acid phosphate plots.

TABLE II. — *Effect of different fertilisers upon the protein content of oats grown in a 3 year rotation of oats, clover, maize, expressed as percentage of protein in the dry matter.*

Fertiliser	Percentage of protein in dry matter				
	1913	1914	1915	1916	Average
None (control) . . . . .	14.56	14.63	13.09	14.92	14.30
Commercial only . . . . .	16.00	15.31	13.57	16.10	15.25
Manure + commercial . . . . .	—	14.69	15.00	15.57	15.10
Manure + nitrate of soda . . . . .	15.13	15.88	16.14	15.80	15.74
Manure + muriate of potash . . . . .	13.81	14.69	12.06	14.06	14.17
Manure + raw rock phosphate . . . . .	14.12	13.69	14.06	14.46	14.08
Manure + acid phosphate . . . . .	14.31	13.94	15.10	14.40	14.44

140 — **The Composition of Grain Sorghum Kernels.** — LE CLERC, J. A. and BAILEY, L. I. in the *Journal of the American Society of Agronomy*, Vol. IX, No. 1, pp. 1-16, bibliography of 7 publications. Washington, D. C., January, 1917.

This paper gives the average results of a large number of analyses of the seed of grain sorghums made at the Office of Cereal Investigations of the Bureau of Plant Industry, U. S. Department of Agriculture, during the 5 years 1908 to 1912, from crops grown at the Panhandle of Texas. The varieties analysed were durra, durra kafir, kafir, kaoliang, milo, broom corn, shallu. From the data obtained interesting conclusions were drawn regarding: — 1) the correlation between the various chemical and morphological characters; 2) the influence of rain on the quantity and quality of the product.

A) CORRELATION OF CHARACTERS. — 1) Unlike wheat, there is no well-defined relation between the weight of 1000 grains of sorghum and the protein content (see Table I). In the milos alone there appears to be a slight tendency towards a positive correlation, i. e., the heaviest grains are the richest in protein. In the other varieties the correlation is inclined to be negative.

2) Low protein content is usually accompanied with a high weight per bushel, and a low content in fibre, ash and pentosans.

3) There is often a correlation between large grains and a low fibre content; large grains have a relatively smaller superficial area than small grains, and consequently less bran, in which the greater part of the fibre is found. With this negative correlation with fibre goes also a negative correlation with ash.

4) There is a positive relation between the ash content and the protein and fibre content, but a negative relation between the ash content and the weight of 1000 grains and the weight per bushel.

B) INFLUENCE OF METEOROLOGICAL FACTORS. — The vegetative period, from April to ripening, was divided into three parts: — 1) April to emergence, 2) emergence to heading; 3) heading to ripening.

Table II summarises the averages of the data obtained. The rainfall during the second and third periods did not have any marked influence on the composition or yield; for example, milo, dwarf milo, brown kaoliang, black-hill kafir and red kafir had a high protein content in 1909 and a low protein content in 1908, although the rainfall during the second period was practically the same both years. The same results were obtained for the third period. Nevertheless there seems to be a certain relation between the harvest and the rainfall during the first period *i. e.* from April to emergence and so between the harvest and total rainfall.

The amount of protein per acre is higher when the rainfall is heavier. Thus, in 1908 and 1911, when there was a copious rainfall throughout the vegetative period and during the first period, the average protein yield per acre was from 181.4 to 245.4 lbs., whereas in 1909, 1910 and 1912, when the rainfall was less, the average protein yield varied between 66.8 and 110.3 lbs. per acre. The same relations observed for protein yield were also observed for grain yield.

TABLE I. — Relation of protein content to the other constituents of sorghum.

Variety	(Protein) % N. x 6.25	Water	Ash	Fat	Fibre	Carbohydrates	Weight of 1000 grains	Weight per bushel
	%	%	%	%	%	%	gram.	lbs.
<i>Milo:</i>								
Protein less than 10.75 % . . . . .	10.69	9.36	1.59	3.27	1.43	73.69	34.9	58.2
Protein more than 13.70 % . . . . .	13.75	9.25	1.66	3.08	1.50	70.76	36.1	58.1
<i>dwarf Milo:</i>								
Protein less than 9.62 % . . . . .	9.56	9.48	1.54	3.37	1.39	74.65	29.8	58.8
Protein more than 13.50 % . . . . .	13.56	9.57	1.67	3.23	1.53	70.48	32.1	57.7
<i>brown Kaoliang:</i>								
Protein less than 11.50 % . . . . .	11.49	9.35	1.84	4.17	1.27	71.96	19.0	56.7
Protein more than 14.70 % . . . . .	14.75	9.88	1.95	4.07	1.50	67.94	17.7	55.2
<i>black-hill Kafir:</i>								
Protein less than 12.60 % . . . . .	12.56	9.45	1.66	3.53	1.58	71.30	23.1	58.7
Protein more than 15.20 % . . . . .	15.25	9.60	1.85	3.44	1.57	68.22	20.8	58.1
<i>red Kafir:</i>								
Protein less than 11.20 % . . . . .	11.13	9.02	1.60	3.12	1.44	72.80	21.5	58.6
Protein more than 13.70 % . . . . .	13.75	9.82	1.79	3.22	1.46	69.96	20.5	57.9
<i>wine and Durra-Kafir:</i>								
Protein less than 12.46 % . . . . .	11.90	9.55	1.87	3.57	1.39	—	24.4	57.9
Protein more than 14.60 % . . . . .	15.08	9.08	1.95	3.58	1.63	—	23.7	55.5



TABLE II. — Influence of rainfall on the protein yield and the grain yield (averages).

Year	Protein %	Rainfall				Yield of grain per acre lbs.	Yield of protein per acre lbs.
		Total April to ripening, inches	April to emergence, inches	Emergence to ripening, inches	Heading to ripening, inches		
1908 . .	12.05	16.24	5.42	8.27	3.81	2 041	245.4
1909 . .	13.55	12.77	1.65	8.84	2.80	493	66.8
1910 . .	13.57	10.04	3.44	5.49	2.74	680	91.1
1911 . .	11.71	16.44	8.30	4.68	2.52	1 568	181.1
1912 . .	13.96	10.68	2.17	6.06	2.84	795	110.3

141 — The Action of the Constituents of the Ash on the Life of Plants. — EGOROV, L. in: I *Журнал Опытной Агрономии* (Journal of Experimental Agriculture, Vol. XVI, Pt. 4, pp. 270-280. Petrograd, 1913. — II. *Ibid.*, Vol. XVIII, Pt. 1, pp. 1-13-2 figs. 1917.

I. — The direct cause of the ripening of Gramineae, shown by the yellowing of the plant, is the migration of large quantities of magnesium to the seed where it becomes fixed. In support of this hypothesis the author quotes the work of ARENDT and of WILLSTÄTTER (1), and describes his own experiments on oats, with and without castration, in which a chemical and morphological examination showed that, towards the period of ripening, castrated oats remain green. This is probably due to the fact that the magnesium does not leave the circle of the vital functions of the plant, so that there is no visible decrease in chlorophyll.

If later experiments confirm this hypothesis of the action of magnesium in the ripening of oats, it may be possible to solve the more important problem of why annual plants are only annual and not perennial.

II. — The action of the constituents of the ash on the life of plants is not sufficiently well known, and this second study is only an attempt to ascertain some specific properties of potassium. The experiment carried out by the author with young maize plants and a full-grown barley plant proves that, contrary to SROKLASA's thesis, the synthesis of the organic substance which takes place in the plant is not modified in ratio to the decrease of potassium oxide in the food. This modification is not sufficiently great to inhibit more or less the vegetative life of the plant (with regard to the amount of potash), but one function (perhaps even a series of functions) is essentially disturbed by a decrease of potash in the food; this function is the filling, or rather the emptying, of the grains of carbohydrates. In other words, the decrease of potash in the food results immediately in the transition of the carbohydrates from the organs in which their synthesis takes place to the parts where they accumulate temporarily. This fact accords with

(1) WILLSTÄTTER, Untersuchungen über Chlorophyll, 1913. — ARENDT, *Landwirtschaftliche Versuchs-Stationen.*, I, 1859. (Ed.)

the previous observations of M. ARENDT, according to which a small amount of potassium oxide remains in the grain, while the greater part, on the one hand, accumulates, after having fulfilled its functions, in other parts of the plant, and, on the other hand, passes into the soil or nutritive solution.

42 - **The Effect of Greenhouse Temperatures on the Growth of Cereals.** — HUTCHESON, T. B. and QUANTZ, K. E., in the *Journal of the American Society of Agronomy*, Vol. IX, No. 1, pp. 17-21, 1 fig., 2 plates. Washington, D. C., January, 1917.

The results are given of studies on the effect of different temperatures on the growth of wheat, oats, barley and rye from the date of sowing, December 21, 1915, till May 27, 1916, when the experiment was discontinued owing to the extreme heat in the houses. Four temperatures were chosen and kept constant, so far as possible, throughout the experiment: 75°F., 50°F., 62°F. and 58°F. The appended Table shows that the temperature has a considerable influence on the periods of heading, flowering and ripening of the different varieties. The order of maturity was sometimes almost reversed; thus at 75°F. oats headed first, at 58°F. rye was the first to head and oats came last. The Table also gives the number of tillers and heads for each plant and the average length of the culms and heads.

*Data on the growth of wheat, oats, barley and rye in greenhouses kept at various temperatures.*

Experiment	Dates				Number per plant		Average length, inches	
	Emergence	Heading	Flowering	Ripening	Tillers	Heads	Culms	Heads
<i>Wheat.</i>								
5 <sup>th</sup>	Dec. 28	May 10-27	May 13-27	—	8.75	0.87	35.05	4.24
5 <sup>th</sup>	<i>id.</i>	May 15	May 20	—	8.00	1.75	31.48	3.28
2 <sup>nd</sup>	<i>id.</i>	Apr. 26	Apr. 29	May 29	5.37	3.00	45.05	4.38
8 <sup>th</sup>	Dec. 31	May 2	May 3	—	1.25	1.12	36.74	3.08
<i>Oats.</i>								
5 <sup>th</sup>	Dec. 29	Apr. 17	Apr. 26	May 21-27	9.00	4.62	30.46	7.13
5 <sup>th</sup>	<i>id.</i>	<i>id.</i>	<i>id.</i>	<i>id.</i>	5.62	3.50	32.12	8.75
2 <sup>nd</sup>	<i>id.</i>	Apr. 25	Apr. 29	May 27	3.37	2.00	34.54	8.00
8 <sup>th</sup>	Dec. 31	May 1	May 5	—	1.50	1.29	30.46	7.70
<i>Barley.</i>								
5 <sup>th</sup>	Dec. 29	—	—	—	48.25	—	—	—
5 <sup>th</sup>	<i>id.</i>	May 25	May 26	—	23.87	—	—	—
2 <sup>nd</sup>	<i>id.</i>	May 16	May 17	—	8.00	1.12	21.29	2.60
8 <sup>th</sup>	Dec. 31	May 2	May 5	—	1.75	1.75	23.42	2.38
<i>Rye.</i>								
5 <sup>th</sup>	Dec. 28	Apr. 25-May 27	May 3-27	—	20.25	1.12	31.30	4.64
5 <sup>th</sup>	<i>id.</i>	Apr. 29	May 1	—	5.00	1.62	40.65	1.25
2 <sup>nd</sup>	<i>id.</i>	Apr. 18	Apr. 25	May 27	5.37	3.00	45.05	4.38
8 <sup>th</sup>	Dec. 31	Apr. 17	May 2	—	1.00	1.00	60.31	4.88

The most interesting results may be summarised as follows. —

1) A cool temperature produces earlier maturity, except in the case of oats; a high temperature stimulates a rank growth of tillers, thus wasting energy needed for the formation of the heads.

2) The cereal most susceptible to heat is barley, which produces a great number of tillers which do not head. Wheat and rye also suffer considerably, but less than barley. Oats suffer very little.

3) The grain yield is highest for the plants grown at cool temperatures, except in the case of oats, which shows no difference in this respect.

143 — **The Selection of Cereals in Sweden and the Increased Production thus Caused** — NILSSON, N. HJALMAR (Lecture and report read before the Swedish Seed Society, 1917), *Sveriges Utsädesförenings Tidskrift*, Year XXVII, Pt. 4, pp. 172-203, 11 tables, 5 figs. Malmö, 1917.

Already before MENDEL's theory, taken up anew by DE VRIES, COURENS, TSCHERMAK, had given a new impulse to the improvement of cultivated plants by selection and hybridisation, Prof. NILSSON EHLE, in his work on hybridisation at Svalöf, has admitted clearly the existence of hereditary units which are transmitted integrally and independently of each other, and from 1900 onwards, in his selection experiments by pure line he applied the methods and conceptions enunciated by JOHANNSEN.

It was from 1900 that the activity of the Experiment Station of Svalöf, working on a modern scientific basis, and following a well-defined, practical aim, began to have a definite influence on the agricultural development of Sweden, with excellent effects, especially on the cultivation of cereals.

It is known that the productivity of a given plant varies from one locality to another, according to the special environmental conditions. Thus a wheat giving a good yield in England may, on account of its slight resistance to cold, give very bad results in Sweden; such is the case of Square-head wheat. The selector, therefore, aims above all at uniting in one individual the characters *high intrinsic yield* and *resistance to the most unfavourable meteorological factor or phenomenon* in a given district. For this reason were established branch Stations, each with their own experimental fields, to complete and extend the activity of the main Station at Svalöf by forming centres of study in distinct districts differing from an agrogeological and meteorological point of view, such as Ultana, Luleå, Långköpings (We-tgöta), etc.

*Resistance to cold* is the most indispensable quality for every cereal in the south as well as in the north of Scandinavia. Moreover, certain districts in the east of Sweden have so little rain in spring that it is also necessary to introduce *drought resistant* varieties. Finally, in Svealand, the fertility of the soil causes such a rapid and rank growth of the culms that varieties very *resistant to lodging* are essential.

It has thus been possible to create, among the different varieties of cereals, various types, all of which are good producers and adapted to different and well-defined meteorological and agrogeological conditions. The Primus barley does well in cold, moist, heavy soils, whereas the varieties Gull and Hännchen prefer a dry climate and light soils; Guldregn on the

which are the most widely cultivated, owe their popularity to their earliness and a capacity for adaptation almost equal to that of the native varieties, whereas Fyris oats are suited to clay soils, and the Klock variety, peat or marsh soil rich in organic matter.

The author gives, in chronological order, the results obtained during the 25 years 1889-1915, in the selection of wheat (winter and spring), rye, barley and oats (white and black). Numerous tables (the most important of which are summarised here) give the details necessary to judge the work done; the yields in grain of the best varieties successively created and propagated by the Svalöf Station are all compared with the average yield of the native varieties, taken as 100.

**WINTER WHEAT (I).** — This must, above all, be resistant to low temperatures. This explains the reason why Squarehead, an excellent English variety which has been used for the progressive improvement of the native varieties, but which, coming from less northerly districts, is more susceptible to cold, gave, in 1916, yields in grain inferior to those of native Swedish wheat (see Table I).

In 1890 the author, by individual selection, was able to isolate two lines, Renadier and Extra Squarehead I, the first of which is distinguished by its quantity and quality of grain produced, as well as by the strength of its stems, the second by its resistance to cold and rust. By crossing these, he sought to unite their qualities in one individual, he obtained Extra Squarehead II, which is superior to both the parents.

TABLE I. — *Relative indices of productivity of different varieties of winter wheat.*

Southern Sweden		Central Sweden (comparison with Svalöf)		
		Svalöf	Linköping	Uttuna
Barley . . . . .	140			
Extra . . . . .	135	0 826 Thule III . . . .	—	125.0
II . . . . .	135	0 825 Thule II . . . .	128.5	121.1
Extra . . . . .	131	0 823 . . . . .	113.4	111.7
I . . . . .	131	0 200 Renadier Squarehead . . . . .	124.0	107.8
Extra-Squarehead II . . . . .	129	head . . . . .	100.0	100.0
Extra . . . . .	128	0 700 Native Swedish . . . . .	120.1	112.0
Renadier III . . . . .	125	0 820 Thule I . . . . .	119.0	99.7
Renadier I . . . . .	121	0 325 Pudel . . . . .	122.4	104.4
Helmina . . . . .	115	0 406 Bore . . . . .		82.5
Extra-Squarehead I . . . . .	112			
Native Swedish wheat . . . . .	100			
Extra-Squarehead . . . . .	99			

In the relative indices of productivity a fairly good position is held by Sol variety, derived by individual selection (pure line) from a Swedish variety. More resistant to cold and earlier than Extra Squarehead, it

(1) See R. Rev., 1917, No. 135. (F.)

is much in demand among the farmers of Götaland, where the rather southern types are not adapted to the climate.

The cross Extra Squarehead II  $\times$  Sol I gave the hybrid Sol II, which holds almost the first place in the scale of relative indices of productivity and is to be recommended on account of its specific resistance to lodging.

From the native Swedish wheat by pure strains was obtained, in 1895 besides the Sol variety, the Kotte variety, also very resistant to cold and rust but unsatisfactory on account of its bad quality grain and weak straw. By crossing it with Grenadier, M. EHLE (1) united in one type, called Pansar, the characters *productivity* and *resistance to lodging* of Grenadier, and the characters *resistance to cold* and *resistance to rust* of Kotte. Pansar wheat now gives yields which exceed by 40 % those of the native varieties. In 33 cultural tests in 1915 it gave in 7 cases more than 18  $\frac{1}{4}$  cwt. per acre, in 8 cases, less than 16 cwt. and in 18 cases between 16 and 18  $\frac{1}{4}$  cwt. per acre.

The cross Extra Squarehead II  $\times$  Småhvetet (early, productive Dalgemar wheat) gave the hybrid Fylgia, which, in the north of Scania, has proved to be productive and earlier even than Pansar.

To what extent is it possible to introduce into other districts of Sweden the varieties created at Svalöf? An answer to this question is found in table I, which compares data obtained at Svalöf (southern Sweden) with that of Linköping and Ultuna (central Sweden); it shows that the varieties nodlad Squarehead, Bore and Pudel, good at Svalöf, decrease rapidly in value as they go further north and, at Ultuna, are much inferior to native wheats. In 1904 M. EHLE crossed these (resistant to cold, ripening early) with the Pudel variety (productive, resistant to rust and lodging) and obtained successively the hybrids Thule I, Thule II and Thule III. The second and the third even more, are excellent types for the north; at Ultuna Thule III has a productivity index of 115, i. e. exceeding that of the native types by 25 %.

To sum up, at the present time Pansar and Fylgia combine, in good proportions, the characters *productivity* and *resistance to unfavourable meteorological phenomena*, but it has not yet been possible to unite in one type all the valuable characters of the parents to the exclusion of all their defects, so that new improvements still remain to be obtained, it is hoped, by experiments now in progress.

SPRING WHEAT (2). — Spring wheat must both give a good yield and ripen early. This second condition is realised by the native wheats, not the first. The selection of native wheats by pure strains, undertaken in 1890, gave the varieties Vårpår and Svalöfs Kolben. By crossing the first with 0201 (a productive, but inferior quality type of Squarehead), two new hybrids were obtained which could be advantageously grown in Scania.

A different series of experiments is in progress for the southern districts. From among the descendants of the hybrid Kolben  $\times$  native Dalmarnes

(1) See R. March, 1916, No. 286. (Ed.) — (2) See R. Sept., 1917, No. 806, fig.

was isolated a line which, while very early, produces on an average 8 % more than Kolben. By representing the productivity of Kolben by the index 100, the following indices are obtained for the other above mentioned varieties; —

Vårpärl . . . . .	107.5	Vårpärl × 0201 . . . . .	110.6
0201 . . . . .	111.7	Kolben × 0201 . . . . .	112.9

RYE (1). — The point of departure for the selections was Östgöta råg (grey rye of Östergötland), and the last variety obtained is Stjärn, which yields 40 % more than the original native type. A valuable variety, Förädlade Wasa (obtained by individual selection from the Wasa variety), because its resistance to cold allows it to be grown in the Norrland, beyond the belt of the Stjärn variety.

TABLE II. — *Relative indices of productivity of the different varieties of rye.*

Varieties	Svalöf 1907-1915	Östergötland 1910-1915	Ultuna 1910-1915
Stjärn . . . . .	139.4	120.4	118.0
Leikuser . . . . .	130.2	110.6	112.1
Irstagner . . . . .	127.6	107.8	99.1
Förädlade Wasa . . . . .	122.9	109.1	107.1
Östgötsk rye . . . . .	118.7	—	109.9
Falskummar . . . . .	112.8	—	—
Wasa . . . . .	103.9	—	99.3
Östgötsk rye . . . . .	100.0	100.0	—
Native Ultuna rye . . . . .	—	—	100.0

Varieties of rye which gave excellent results at Svalöf and Östergötland did very poorly at Ultuna, but now selection and hybridisation experiments with native rye have been undertaken, and it is hoped to obtain varieties better suited to the northern latitudes.

TABLE III. — *Relative indices of productivity of the different varieties of barley.*

Varieties	Scania		Östergötland		Ultuna
	Svalöf 1909-1916	Various localities 1908-1916	1909-1916	1897-1910	1900-1916
Ölfkon . . . . .	107.6	112.6	113.5	122.2	116.6
Trusås . . . . .	103.5	104.2	107.3	115.6	109.9
Isancken . . . . .	101.4	103.5	108.3	120.1	—
Hevall . II. . . . .	94.4	97.5	102.2	111.1	105.3
Vanhals . . . . .	92.8	—	—	101.1	101.1
Svenskt Plymase . . . . .	—	—	—	100.0	100.0
Trinus . . . . .	100.7	—	—	104.4	95.4
Native Swedish barley . . . . .	100.0	100.0	—	—	—
Östgötsk . . . . .	—	—	100.0	—	—

(1) See R. 1916, No. 287 (Ed.)

**BARLEY (1).** — For this cereal the results of selection are less obvious than for wheat and rye. It must, however, be noted:— 1) that, besides the yield, the quality of the grain for brewing must be largely considered, thus limiting the *quantitative* effects of selection; 2) that, at Svalöf, selection work was not begun with native types, but with the English barley *Practice*, already improved, from which were obtained, by pure strains, the *Princess* variety, suited to light soils, and the *Chevalier* variety, suited to cold, heavy soils. Another variety, *Hannchen*, earlier and with strong straw, is one of the best, but is already surpassed by *Gullkorn*, a productive variety, resistant both to lodging and cryptogamic diseases.

**WHITE OATS.** — Selection was started with the *Propsteier* variety, already improved and productive, so that, like barley, the results do not, at the first glance, appear very remarkable. It is, however, sufficient to compare the last varieties obtained with the older, but still popular, native types, such as *Ligowo II*, *Kubb*, *Föräddlad Dala* (selected *Dala*) to be convinced of their superior yield; thus, the new variety *Kron* produces 35% more than *Kubb*. The variety *Seger* is also distinguished by the whiteness of its grain and *Guldregn* by the strength of its straw, the earliness and quality of its grain and its very thin glumes. The *Svalöf* oat varieties, unlike those of wheat and rye, also gave excellent results at *Ultuna*, as is seen from Table IV.

TABLE IV. — *Relative indices of productivity of the different varieties of oats.*

	White oats			Black oats		
	Svalöf	Ultuna		Svalöf	Linköping	Ultuna
<i>Kron</i> . . . . .	106.3	102.7	<i>Klock III</i> . . .	121.3	114.4	101.8
<i>Seger</i> . . . . .	103.5	110.7	<i>Stormogul</i> . . .	120.7	111.8	99.9
<i>Guldregn</i> . . . .	102.5	107.9	<i>Klock II</i> . . . .	110.0	107.0	103.7
<i>Propsteier</i> . . . .	100.0	100.0	<i>Klock I</i> . . . . .	109.5	—	—
<i>Ligowo II</i> . . . .	98.9	90.7	<i>Fyrils</i> . . . . .	102.3	117.2	103.3
<i>Föräddlad Dala</i> . .	86.9	—	<i>Tartarisk Plym</i> .	—	75.5	88.7
<i>Kubb</i> . . . . .	78.4	—	<i>Roslag</i> . . . . .	100.0	100.0	100.0

**BLACK OATS (2).** — Selection was started with the varieties *Roslag* and *Tartarisk Plym*. From the former was obtained the variety *Fyrils* (which holds first place at *Linköping*), from the latter, the varieties *Klock I* and *Stormogul*.

The cross *Klock I* × *Guldregn* (white) gave the hybrid *Klock II*. This crossed in its turn with *Stormogul*, gave *Klock III*, which unites, in good proportion, the characters of the parents. The cross *Klock II* × *Fyrils* has not yet given very definite results. Of importance are the attempts to cross the last varieties obtained at *Svalöf* with the native, northern types

(1) See *B. 1915*, No. 369. (Ed.) — (2) See *R. May*, 1917, No. 422. (Ed.)

with the aim of uniting in one type the productivity and quality of the best varieties with the resistance to cold characteristic of the northern oats. The first result is the hybrid 01163 Dala × Guldregn, superior to Dala in yield, resistant to cold, and earlier than Guldregn, which it could replace in the northern provinces. Very promising also are the hybrids Ligowo × Nordbisk = Björn, and Ligowo × Nordland = Orion. All this hybridisation material has been sent for further study to the branch stations of Vesterbørdland, where the climatic conditions are more severe and difficult.

INCREASE IN THE PRODUCTION OF GRAIN DURING THE LAST 25 YEARS. — The new varieties created at Svalöf and distributed more or less widely towards the north, certainly produce much more than the native varieties, which they are gradually replacing entirely. This fact cannot fail to influence the production of grain, but there are no exact statistics which make possible to determine to what extent the increased yield is due to the adoption of the new varieties, to the sowing of a larger area, or to the use of improved methods.

In the province of Malmöhus, the production of wheat which, during the five years 1889-1893, was 938 100 bushels, rose in 1909-1913, to 2 941 000, i. e. it was three times as great, and the largest increase was in 1899-1903, the time when seed selected at Svalöf began to be used in extensive cultivation. Similar results were observed in the province of Kristianstad. With regard to increased production the districts of Sweden may be divided into three categories: —

- 1) Scania (provinces of Malmöhus and Kristianstad) . . . . . 200-300 %.
- 2) Götaland and Värmland . . . . . 100 %.
- 3) Svealand (provinces of Gotland, Dalarna and Gefleberg) . . . . . 25-30 %.

In proportion as the north is approached the introduction of seed from Svalöf becomes more difficult and the results less certain, so that the increase in yield in the north is very limited.

It is interesting to determine in what proportions the three above-mentioned categories have contributed to the increase in production during the last 25 years. During the first five year period, 1889-1893, Svealand (category 3) holds the first place with 43.3 %, i. e. almost the half of the total production; then comes Scania with 34.5 %, and finally Götaland-Värmland with 23.2 %. During the last five year period, 1909-1913, the categories come in the following order: — Scania, 51.5 %; Svealand, 27 %; Götaland-Värmland, 21.5 %.

During the first five year period, 1889-1893, Sweden produced in all 717 671 imperial bushels of wheat; during the last, 1909-1913, it produced 494 838 bushels. In 1889-1893, 6 031 303 bushels of wheat were consumed, of which 50.6 % was supplied by the country and 49.4 % imported. In 1899-1903 the increased consumption was not compensated for by a proportionate increase in production, which does not represent more than 41.1 % of the total quantity consumed (8 998 073 bushels). Finally, in 1909-1913, in spite of the greater amount consumed (10 198 848 bushels), the wheat produced in Sweden rose again, and that imported fell to 46.4 % of the to-



tal consumption. By representing these fluctuations by relative indices the following figures are obtained: —

	1889-1893	1893-1903	1904-1910
Production . . . . .	1.01	1.2	2.0
Importation . . . . .	1.00	1.8	1.7

As is seen above, the effect of selecting superior types is first felt in the Scania district, where the climate is the same as that of Svalöf. The work of the branch stations, especially in Svealand, will allow the cultivation of wheat to be extended advantageously over large areas, where, at present it cannot compete with barley and rye, and will help to decrease importation, seeing that the consumption curve tends to become horizontal. This rapid survey of the history of wheat in Sweden during the last 25 years, shows what results may be obtained, even in a short time, by the propagation of ultra-selected varieties.

For the other cereals—barley, oats and rye — it is more difficult to determine to what extent the varieties created at Svalöf have contributed to the increased production.

All the winter cereals, considered together, gave, in 1880, a yield of grain of 10.65 cwt. per acre, and in 1910, 13.38 cwt. The yield curve, which had remained more or less horizontal from 1885 to 1899, rose suddenly in 1909, just at the time when the seed from Svalöf began to be used in southern Sweden. As for the spring cereals, their yield per acre was 10.35 cwt. in 1880, 12.90 in 1910, and tended to increase, especially after 1905, that is to say, was in full keeping with the work of the main station at Svalöf.

Finally, to give an idea of the financial results obtained by the propagation of selected wheat, it is sufficient to mention the following facts: in the province of Malmöhus alone, Pansar and Fylgia wheats, by increasing the yield by 7.8 %, gave a profit of about 1 million *crowns*, whereas Klock III oats, which yield 12 % more than Klock I, gave a profit of almost 4 million *crowns*, the cost of production remaining identical.

144 — **Linked Quantitative Characters in Wheat Crosses.** — FREEMAN, GEORGE F. *The American Naturalist*, Vol. LI, No. 611, pp. 683-689, 5 tables. New York, November, 1917.

As the varieties of hard wheat and soft wheat used in the crosses described differ in having a number of visible characters exceeding that of the chromosomes (8) in the sexual cells, it was thought probable that a genetic linkage (1) of some of these might be found. The author

(1) Linkage was discovered in 1906 by BATESON and PUNNETT, who called it genetic coupling. By crossing the *Pisum sativum* varieties with purple flowers and long pollen grains with other varieties with red flowers and round pollen grains, it is seen that the 2 characters derived from each parent tend to be transmitted coupled, as if the respective determinants were found in one and the same chromosome. Cf. MORGAN, STURTEVANT, MULLER and BAIRD *The Mechanism of Mendelian Heredity*, pp. 48-77. London, Constable and Co., Ltd., 1915. On this subject see *R. January*, 1918, No. 29. (Ed.)

undertook a study in order to determine if such a linkage exists between the texture of the grain (translucency or opaqueness) and the shape of the head determined by the ratio *width: thickness* (flattened heads and square heads).

One of the parents, No. 1, had hard, translucent grains and a flattened head; the other, No. 35, had soft, opaque grain and a nearly square head.

The hybrids of the  $F_1$  (1914) were intermediate to the two parents, both in the shape of the head and the texture of the grain (See Table I). In the  $F_2$  were found every possible degree of intergradation between the hard and soft grained variety. In order to facilitate the classification of the grains the author divides them into three groups: —

1st. *Group*: — Grains approximately resembling those of hard wheat. Hardness = 100.

2nd. *Group*: — Grains approximately resembling those of soft wheat. Hardness = 0.

3rd. *Group*: — All intermediate grains. Hardness = 50.

This classification allows the degree of hardness for each plant to be determined with facility. Thus, a plant having 60 % hard grains, 30 % intermediate grains, and 10 % soft grains, would be classified as follows:  $(0.60 \times 1.00) + (0.30 \times 0.50) + (0.10 \times 0) = 0.75$ , or 75 %.

Having classified the grains in this manner, the plants themselves may be divided into three groups.

	Percentage of hardness
1st. <i>Group</i> : — Hard wheats	over $66 \frac{2}{3}$
2nd. <i>Group</i> : — Intermediate wheats	$33 \frac{1}{3}$ to $66 \frac{2}{3}$
3rd. <i>Group</i> : — Soft wheats	less than $33 \frac{1}{3}$

**CORRELATION BETWEEN THE TEXTURE OF THE GRAIN AND THE SHAPE OF THE HEAD.** — The flatter a head is, that is to say, the more its width exceeds its thickness, the higher will be the ratio or quotient obtained by dividing the first by the second. Is there any correlation between the degree of hardness of the grain and the value of this quotient? Table I gives, on this subject, data obtained in 1914 for the parents No. 1 and No. 35 and their  $F_1$  hybrids whereas Table II summarises the results concerning: 1) the parents and hybrids of  $F_2$  in 1915; 2) the parents and hybrids  $F_3$  in 1916.

Tables I and II show there is a marked correlation between the texture of the grain and the shape of the head: the hardness of the first increases progressively in proportion as the ratio *width: thickness* increases in the second. Are we here concerned with a true genetic correlation, or a simple physiological correlation due to the fact that long, thin, hard grains, or in starch, thus less capable of filling the glumes than are soft, well rounded grains, rich in starch, tend to form a flattened head? This problem may be solved in various ways: —

1) In the pure line of hard wheat No. 1 are always found soft grains, the number and proportion of which vary with the individual. Those plants producing a *smaller* proportion of soft grains have not more flattened heads

TABLE I. — Data concerning the two parents and their hybrids of  $F_1$  (TQI4)

[illegible]

TABLE II. — Data concerning the two parents and their hybrids of  $F_2$  (1915) and  $F_3$  (1916)

1945				1946			
Total number of ratio plants	Average value of ratio width thickness	Character of grain	Total number of plants	Average value of ratio width thickness	Character of grain		
298	1.57	Hard	253	1.45	Hard		
352	1.55	Intermediate	55	1.59	Intermediate		
603	1.55	Hard	2 275	1.33	Intermediate		
1 276	1.29	Intermediate	1 201	1.74	Soft		
332	1.11	Soft	441	1.69	Soft		
1 045	0.95	Soft	541		Soft		

than those producing a *larger* proportion of soft grains, as would be the case in physiological correlation.

2) There are varieties of hard wheat with square heads, and varieties of soft wheats, such as Little Club, with rather strongly flattened heads.

3) Plants which have an abnormal correlation between texture of the grain and the shape of the head transmit it to their descendants, as is shown by the figures for 1915 and 1916 given in Table III. In this case physiological correlation can play no part, whereas the phenomenon could easily be explained by genetic correlation, by the theory of exchange of elements between chromosomes as expressed by MORGAN's "cross over" theory (1). In any case, it cannot be a question of physiological correlation.

TABLE III. — *Inheritance of non-conformity to usual correlation between the shape of the head and the texture of the grain.*

Number	Parents (1915)		Descendants (1916)	
	Ratio width: thickness	Per cent hardness	Ratio width: thickness	Per cent hardness
132	<b>0.93</b>	98	<b>1.34</b>	88
169	<b>1.16</b>	50	<b>1.34</b>	73
219	<b>1.20</b>	50	<b>1.35</b>	93
232	<b>1.25</b>	100	<b>1.33</b>	86
249	<b>1.33</b>	60	<b>1.30</b>	88
293	<b>1.00</b>	64	<b>1.17</b>	61
279	<b>1.21</b>	50	<b>1.35</b>	79

It may be objected that, if there were a constant genetic link between the characters "shape of head" and "texture of grain", the linkage should be complete, whereas, on the contrary, there is considerable regression. This objection may be met by the observation that, apart from the fact that these characters are *quantitative*, and, therefore, subject to fluctuation around a mean, it may be admitted that the genetic factor for the texture is linked only with *one* of the factors determining the shape of the head. This would result in the partial correlation found.

CONCLUSION. — The data presented seem to show that the two characters, "hardness of grain" and "high ratio width: thickness" derived from the hard wheat parent No. 1, tend to come out together in the segregates of the  $F_2$  and  $F_3$  generations, *i. e.*, that there is genetic linkage between one or more of the factors (genes) controlling the grain texture and head shape in the two varieties employed as parents.

145- Selection of "Kanred" a New Wheat Variety, in Kansas, U. S. A. — See No. 150 of this Review.

1. See R. January, 1918, No. 29 (*Fd*)

146 - Studies on the Contamination of the Pollen of Rye with the Help of "Indicator Plants" in Sweden. — HERBERT-NILSSON, N. (Seed Selection Station of Weibullsholm, near Landskrona, Sweden), in *Zeitschrift für Pflanzenzüchtung*, Vol. V, Pt. 2, pp. 80-82, fig. 7-16, V tables. Berlin, 1917.

In his experiments on the selection of rye at the above mentioned station, the author uses a method differing in many respects from that usually followed; instead of sowing the descendants of the selected plants side by side, he scatters them in fields of wheat or fodder Gramineae in order to prevent their crossing.

In such work it is necessary to determine the manner and proportion in which the pollen of a plant, or group of plants, when carried by the wind may reach the flowers of other plants, even if they be at a considerable distance. This may be done in three ways: —

- 1) The determination of the percentage of flowers setting in plants almost completely self-sterile, cultivated apart.
- 2) Direct collection of the pollen.
- 3) The use of "indicator plants" ("indicators").

1) PERCENTAGE OF FLOWERS SETTING. — In normal rye plants this is, on an average, 5 %. Higher averages, exceeding 10 %, may be attributed to contamination by other plants, or groups of plants. According to the author's observations, plants separated from each other by a distance of about 30 metres may be considered as practically isolated. Isolated plants at the same distance not of one plant, but of a group of plants (covering an area of about 0.5 square metres), are exposed to contamination at the rate of 10 %, bringing the percentage setting up to 15 %.

2) DIRECT COLLECTION OF THE POLLEN. — This is done by means of glass slides covered with liquid paraffin, placed at various distances from the rye-plot in the direction of the prevailing wind.

3) THE USE OF "INDICATORS". — In 1913, during work on the selection of the Danish variety of rye, Brattingsborg, the author noticed a plant distinguished, even when fairly ripe, by the persistence of chlorophyll in the stem, leaves and glumes, thus having the appearance of a wild grass. The green parts of the plant, then, *do not ripen* (1).

Hybridisation experiments with the normal type showed this "non ripening" character to be recessive, the  $F_2$  individuals being distributed as follows: 296 normal to 96 green (theoretically, 294 to 98), according to the Mendelian ratio 3 : 1. As this green type is very rare (less than 1 in a million) and recessive, it is particularly well adapted for use as an "indicator" very sensitive to contamination. By studying the descendants of a given individual of this type it is possible to determine exactly the seeds arising from self-fertilisation and those arising from cross-fertilisation (contamination): the former will produce "green" plants, whereas the latter, fertilised by the normal dominant type, will produce normal individuals exclusively. It is, therefore, impossible to find a more exact instrument for measuring contamination.

(1) On the ripening of cereals see No. 141 of this Review. (Ed.).

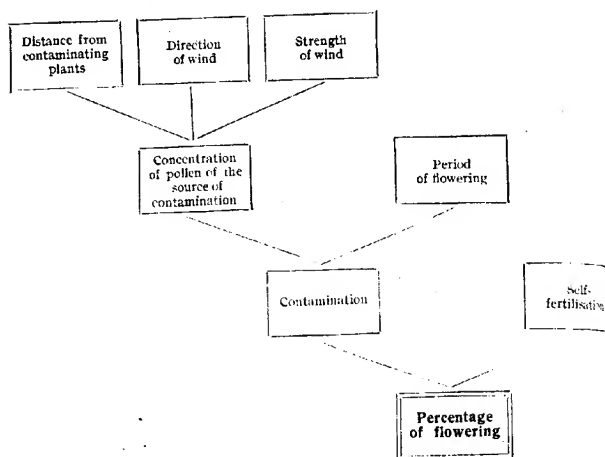
By applying this method it was found that 10 % of the isolated rye plants, at a distance of 50 metres from plots (rye) measuring 1 to 2 square metres, are subject to contamination. The larger the plots, the greater is the danger of contamination, as is shown by the following figures with regard to a rye plot measuring 3 500 square metres :

Distance between isolated plants and plot	Percentage of contamination
50 metres . . . . .	54.4 "
250 " . . . . .	46.3
350 " . . . . .	29.7
400 " . . . . .	19.0

The use of "indicators" allows the effect of contamination on a whole crop to be studied. This is impossible by the usual methods owing to the impossibility of distinguishing between normal plants from self-fertilised seeds and normal plants from cross-fertilised seeds. It was thus possible to determine that the effect of contamination by the 3 500 square metre plot on a group of 20 "indicators" 60 metres away, was 37.3 % i. e.  $\frac{1}{3}$  rd. less than the effect on isolated plants. This difference is explained by the fact that the pollen of 20 plants in a group has a marked protective action.

The fertilisation of a group of plants exposed to contamination is obviously dependent on the state of the pollen mixture which spreads over the lot. The mass of pollen coming from a given group of plants becomes less dense in proportion as the distance it travels from its origin, or "source of contamination" is greater, in other words, its "concentration" is proportionately less strong. In a group A of plants exposed to contamination by another group B, the percentage of flowering depends both on the concentration of the pollen produced by the group A itself, and that of the pollen of group B, whereas the fertilisation of isolated plants depends almost solely on the concentration of the pollen of the "source of contamination", for their pollen concentration is almost equal to nil.

Other experiments have, moreover, shown that plants of the same group, isolated plants situated at equal distances from the "source of contamination" may present widely differing percentages of contamination. Thus, in the 20 plants mentioned above figures were found varying between 9.6 and 68 %. These differences in one group may be explained as follows : the plants do not all flower at the same time ; in proportion as the absolute number of plants increases (and, consequently, the area of the plot), the total period of flowering increases and the amount of pollen spread over the neighbouring plants, or groups of plants, becomes thicker. The late-flowering plants exposed to contamination will, therefore, show a higher percentage of contamination than the early-flowering ones. The percentage of flowers resulting from an almost self-sterile plant exposed to contamination is, therefore, dependent on many variable factors which may be represented by the following figure : —



The use of "indicators" also made it possible to show that the muslin bags placed over inflorescences to prevent access by foreign pollen do not have the desired effect. Rye pollen granules measure  $0.05 \times 0.06$  mm., and easily pass through the openings of this muslin, which have a diameter of 0.15 to 0.20 mm. Four "indicator" plants isolated by means of muslin gave descendants divided up as follows:

Indicators				Descendants			
Number of plants	Number of flowers	Number of seeds	Percentage of flowering	Number of plants	Contaminated plants (ripening normally)	Indicator plants (green)	Percentage of contamination
1045	74	59	79.6	28	14	14	50
1046	112	53	25.0	28	27	1	96.4
1047	50	15	30.0	6	4	2	66.7
1048	74	11	18.9	5	5	0	100

Of the descendants of the "indicator" 1045, half were produced by self-fertilisation, the other half by contamination. It is, therefore, a plant possessing a high degree of self-fertilisation, which shows that the pollen from the rye fields penetrates the muslin so abundantly that it may advantageously compete with the pollen of a self-fertile plant. In the other three cases the percentage setting is lower, an average of 25%, and the average contamination is 83.3%. Consequently, the majority of the plants (more than  $\frac{4}{5}$ ths.) are fertilised by foreign pollen which penetrates the protective hood, thus proving the inefficiency of muslin for isolation purposes.

1. - **Inheritance of Endosperm Colour in Maize.** — WHITE, ORLAND E., in the *American Journal of Botany*, Vol. IV, No. 7, pp. 396-406, 4 tables, bibliography of 11 publications, Lancaster, Pa., July, 1917.

The factors determining the endosperm colour in maize have been studied by many authors (CORRENS, LOCK, HAYES, EMERSON, BURTT-WY, etc.). The author crossed varieties with yellow endosperm, California Golden Pop ( $Z_{14}$ ), with a Hopi variety and *Zea Caragua* ( $Z_{21}$ ), with white endosperms. The results he obtained led him to form conclusions in part widely different from those of preceding authors who admitted the existence of two determinants of the yellow.

In the cross California Golden Pop ( $Z_{14}$ )  $\times$  *Zea Caragua* ( $Z_{21}$ ), the  $F_1$  hybrids had uniformly white endosperms, or, at the most, in certain cases, slightly yellowish ones. The cross California Golden Pop  $\times$  Hopi gave similar results.

Of 9663 grains of the  $F_2$  generation of California Golden Pop ( $Z_{14}$ )  $\times$  *Zea Caragua* ( $Z_{21}$ ), 6999 were white and 2664 were yellow. Assuming the difference between these two varieties to be due to one single factor (monohybridism), the theoretical numbers would be 7248 white and 2416 yellow grains, in accordance with the Mendelian ratio 3 : 1. There is, therefore, a satisfactory agreement between the actual and theoretical values.

With regard to the yellow colour it should be noted : 1) it was lacking uniformly, all shades from a dark yellow to a very light lemon yellow being present on the same ear ; 2) in some ears the yellow was principally confined to the base of the grain, nearest the point of attachment.

By crossing the hybrids  $Z_{14} \times Z_{21}$  of the  $F_1$  generation with the parent (*Zea Caragua*), white grains only were obtained.

In the  $F_1$  generation, of 6208 grains, 4703 were white and 1505 yellow ; according to the Mendelian ratio 3 : 1, the figures should have been 4656 white and 1552 yellow. In this case the white, as well as the yellow grains, showed little uniformity in colour ; this is largely due to the segregation of factors affecting the texture and degree of translucency and opaqueness.

In all the experiments described above the inflorescences were always isolated by muslin or parchment bags (2 leaves). By leaving  $Z_{14}$  in contact with varieties with orange colour grain, fully exposed to cross fertilisation, ears with a large number of orange grains were obtained. From this it may be inferred that the orange grain variety is dominant to the yellow  $Z_{14}$  (California Golden Pop) variety. Under similar conditions,  $Z_{21}$  (*Zea Caragua*) always produced exclusively white grains.

Taking these data as a basis, the author explains the colour differences between  $Z_{14}$  and  $Z_{21}$  by the presence or absence of a single inhibitory factor, which prevents the development of the yellow colour, even in presence of the factor  $Y$ , which determines the yellow pigment. In the absence of this factor the grains may be either yellow or white. Four combinations are possible.

1) AAYY	white endosperm
2) AAyy	white "
3) aaYY	yellow "
4) aayy	white "



By crossing these combinations with each other, the following colors would be obtained for the endosperm of  $F_1$  and  $F_2$ :

Cross	$F_1$	$F_2$
1 (white) × 2 (white)	white (AA $\bar{V}\bar{y}$ )	all white
1 (white) × 3 (yellow)	white (Aa $\bar{V}\bar{Y}$ )	3 white; 1 yellow
1 (white) × 4 (white)	white (Aa $\bar{V}\bar{y}$ )	13 white; 3 yellow
2 (white) × 3 (yellow)	white (Aa $\bar{V}\bar{y}$ )	13 white; 3 yellow
2 (white) × 4 (white)	white (Aa $\bar{y}\bar{y}$ )	all white
3 (yellow) × 4 (white)	yellow (aa $\bar{V}\bar{y}$ )	3 yellow; 1 white

The formula of the California Golden Pop ( $Z_{11}$ ) variety would be aa $\bar{V}\bar{Y}$ , that of the *Zea Caragua* ( $Z_{21}$ ) variety A A  $\bar{V}\bar{Y}$ . All the common varieties with white endosperm would have the formula aa $\bar{y}\bar{y}$ , i. e., would possess neither the determining factor  $\bar{V}$ , nor the inhibitory factor A. These formula would explain all the phenomena and combinations observed during the author's experiments.

148. The Relation of Cob to Other Ear Characters in Maize. — GRANTHAM, A. H. *Journal of the American Society of Agronomy*, Vol. IX, No. 5, pp. 201-217, 13 tables — 1 fig. Bibliography of 4 publications. Washington, May, 1917.

This paper gives the results of a series of studies on the relation of the characters of the cob (size, weight, density) to those of the grain (depth, thickness, weight, yield), made at the Delaware Agricultural Experiment Station from 1910 to 1915. For the work were used 3 500 ears of maize: the Johnson County White variety, cylindrical in shape, with straight row of kernels. Only the upper part of the ear deprived of the tips, so as to leave a cylindrical section 12 cm. long, was used. The following characters were studied:

- 1) Weight of section.
- 2) Number of rows.
- 3) Circumference of ear.
- 4) Thickness of kernel, determined by counting the number of kernels in 10 cm.: minimum number, 18; maximum, 32; average,  $24.87 \pm 0.0229$ .
- 5) Weight of shelled grain or yield in grain: minimum 105 gm.; maximum, 285 gm.; average,  $190.321 \pm 0.2639$ .
- 6) Weight of cob: minimum 15 gm.; maximum, 75 gm.; average,  $36.500 \pm 0.083$ .
- 7) Circumference of cob: minimum, 7 cm.; maximum, 15 cm.; average,  $10.571 \pm 0.011$ .
- 8) Depth of kernel: determined by the difference in the diameters of the cob and ear: minimum, 0.7 cm.; maximum, 1.9 cm.; average,  $1.24 \pm 0.0015$ .
- 9) Weight of individual kernel, determined by counting the number required to weigh 10 gm.: minimum number, 18; maximum, 52; average,  $27.805 \pm 0.0513$ .
- 10) Density of cob: determined by dividing its weight by its circumference: minimum, 0.12; maximum, 0.54; average,  $0.328 \pm 0.0066$ .

The appended table give the coefficients of correlation between the various characters of the cob and those of the kernels, calculated by AVENTPORT's formula (1).

*Coefficients of correlation between the characters of the cob and those of the kernel.*

Characters		Coefficients of correlation
Circumference of cob and	5) Weight of grain per section . . .	0.4118 $\pm$ 0.0095
	6) Weight of kernel . . . . .	-0.0185 $\pm$ 0.0114
	8) Depth of kernel . . . . .	-0.1789 $\pm$ 0.0170
	4) Thickness of kernel . . . . .	-0.1053 $\pm$ 0.0113
Weight of cob and . . .	5) Weight of grain per section . . .	0.3064 $\pm$ 0.0103
	9) Weight of kernel . . . . .	-0.1837 $\pm$ 0.0110
	8) Depth of kernel . . . . .	-0.0747 $\pm$ 0.0113
	4) Thickness of kernel . . . . .	-0.1500 $\pm$ 0.0111
Density of cob and . . .	5) Weight of grain per section . . .	-0.0728 $\pm$ 0.0113
	9) Weight of kernel . . . . .	-0.1959 $\pm$ 0.0111
	8) Depth of kernel . . . . .	-0.0039 $\pm$ 0.0113
	4) Thickness of kernel . . . . .	-0.0513 $\pm$ 0.0114

CONCLUSIONS. — 1) The yield of grain per ear increases with the circumference of the cob; the correlation between these characters is fairly high.

2) There is also a high correlation between the yield of grain and the weight of the cob.

3) The depth of the kernel increases with the density of the cob, but the correlation is slight.

In these three cases, contrary to the following ones, there is positive correlation.

4) An increase in the density of the cob tends to decrease the weight of kernel; the negative correlation is moderate.

5) There is a moderate degree of correlation between the following pairs of characters: circumference of cob and depth of kernel; weight of cob and average weight of kernel; weight of cob and thickness of kernel.

$$(1) \text{ DAVENPORT'S formula: } r = \frac{\sum D_L L_w}{\sigma_L \sigma_w}$$

where  $D_L$  represents the difference between the lengths and average length  
 $L_w$  " " " " the weights and average weight  
 $\sigma_L$  " " standard deviation of the length  
 $\sigma_w$  " " " " of the weight.

The maximum degree of positive correlation is expressed by the coefficient + 1; the maximum degree of negative correlation by the coefficient - 1; the absence of any correlation is represented by 0. Thus, the value 0.4 shows a very high positive correlation, whereas the value 0.1 shows a very low correlation. (Ed.)

6) There is slighter negative correlation between the *circumference of the cob* and *thickness of kernel*.

7) There is a low negative correlation between the pairs of characters: *weight of cob* and *depth of kernel*; *density of cob* and *yield of grain*.

8) The negative correlation between *density of cob* and *depth of kernel* is very slight.

9) There is practically no correlation between the *circumference of the cob* and the *weight of the individual kernel*.

There are, then, in certain cases, clear and well-defined relationships between the characters of the cob and those of the kernels, so that measurements of the cob might be a valuable aid in the selection of maize.

149 - On Abnormal Ears of Maize Obtained from Seeds Treated with Copper. - JUNGELSON, A., in *Revue Générale de Botanique*, Vol. XXIX, No. 344-345, pp. 214-217, 261-285 + 1 fig. + plates 17-21. Paris, 1917.

The experiments described were carried out in 1914 and 1915 to determine the effect of copper salts on the growth of cereals, and of maize in particular.

The 1914 experiments showed that treating maize seed with copper salts had the following effects: -

1) The germinating power of the seeds is weakened.

2) The poisoning of the seedlings is often shown by the appearance of a bluish streak on the leaves.

3) The growth of the plants is slower and flowering is, consequently, retarded.

4) Poisoning of the seeds may give the plants issued from them special capacities, tendencies to vary, shown by the appearance of abnormal ears, which, by their own characters, and by those of the grain they contain are removed from the racial type.

5) These new characters are faulty and retrogressive, and the injurious effects increase with the increased poisoning of the seed -- greater length of time of poisoning, closer contact of the poison and albumen as a result of previous mutilation.

The 1915 experiments gave the following complementary conclusions: -

6) Different copper salts have the same effect.

7) The facility of the plants to give abnormal ears varies with the concentration of the copper solution in which the seed has been placed.

8) Copper has no well-defined effects, and seeds treated in an identical manner give birth to different anomalies.

9) The tendency to vary of a plant from poisoned seed may be shown by qualitative or quantitative effects, by the appearance of multiple anomalies, or of more uniform ones in greater number.

10) The new characters of the seed and the grain are not stable and do not seem to reappear in the descendants.

11) The tendency to vary of the parent-plant is fixed in the seed which produces irregular and retrogressive ears.

PRACTICAL RESULTS. - A) The copper treatment, used in agriculture to protect seeds against cryptogamic diseases, may have an accessory and

rious influence. The specific characters of the varieties cultivated may, under this influence, disappear and be modified in an undesirable sense. The deterioration of local varieties of cereals, of which farmers have so frequently complained during recent years, may be partly due to this anti-cryptogamic treatment, and may prove a serious obstacle to the improvement and selection of the desired characters. It is even possible that chemical poisoning may produce deeper and more lasting results than those obtained in the author's experiments, and that poisoning or development in a medium which is not the customary one may be the cause of diverging types or of deformities.

B) By the action of peculiar and graduated chemical influences easily adapted to experiment, it may be possible to throw some light on the natural factors of evolution, and perhaps also on the mechanism of racial variation. It is of no account if pathogenic actions are concerned, for it is still unknown whether they may not be direct or indirect causes of the variation and evolution of plant species or forms.

- **Correlations between the Chemical and Morphological Characters of Sorghum.** — See No. 140 of this Review.

- **An Interesting Bud Variation in the Duchess Apple.** — DORSEY, M. J., in *The Journal of Heredity*, Vol. VIII, No. 12, pp. 565-567, fig. 9. Washington, December, 1917.

WILLIAM BARDWELL found in his orchard near Excelsior, Minn., a Duchess apple which differs from the others of the same variety in its deeper red colour and harder skin.

Typical Duchess apples are pale yellow, more or less covered with irregular dark red streaks overlying lighter irregular blotches. The sport has the same yellow background, but is covered with a solid, dark red colour on the exposed parts, shading, at the apex, into a lighter red overlaid with darker streaks. The skin, being harder, is more resistant during cooking. It is probably a case of bud variation which, since it shows the same productivity and quality as the parent plant, might be successfully propagated by grafting, and form a new type of great market value owing to its red colour.

It was in this manner that Collamer and Hitchings arose from Twenty Nine, and that Banks arose from Gravenstein, all being forms characterized by a deeper colour. Banks is usually called Red Gravenstein, and similarly the new Duchess type might be called Red Duchess.

- **A Bottle-Necked Lemon.** — SWINGLE, LEONHARDT, in *The Journal of Heredity*, Vol. VIII, No. 12, pp. 559-560, 1 fig. Washington, December, 1917.

Bud sports are much more frequent in the citrus family than is supposed, and are of importance in the improvement and standardisation of varieties.

In a Eureka orchard near Corona, Cal., the author observed a limb sport which had grown till it comprised a large part of the tree. It was distinguished by its bottle-necked fruit and narrow, sharply pointed leaves, resembling those of the willow or peach.

A search led to the discovery of several other identical cases. There

is no transition between the normal part of the tree and the sporting branch. The apparent correlation which is always found between the bottle-necked fruit and the narrow pointed leaves, is of interest.

The fruit of these branches is of inferior quality and market value. This shows the necessity of careful pruning and the rejection, for grafting purposes, of buds or scions showing such variations to however slight a degree.

153 - Cereal Cultural Experiments made in 1916 at the Agricultural Station of Flakö, Sweden. — VON FELTZEN, HJALMAR, in *Svenska Mosskulturlörens Tidskrift*, Year XXXI, No. 6, pp. 465-469. Jönköping, 1917.

1) SPRING RYE AND WHEAT, BARLEY AND OATS. — In yield of grain oats hold the first place, followed by barley, rye and wheat.

	Variety	Beginning of earing	Duration of growing period, days	Grain Yield	
				Cwt. per acre	Compared with that of oats = 100
Oats . . . .	Seger	July 25	138	21.10	100
Barley . . . .	Korn	July 15	119	19.70	93
Rye . . . .	Primus	June 25	131	15.80	75
Wheat . . . .	Jätte	July 20	138	16.20	77

As in the previous year Gulkorn barley gave a yield much superior to that of Primus; taking that of Primus as 100, the values 140, 167, 114 were obtained for the years 1914, 1915, 1916, respectively.

2) COMPARATIVE EXPERIMENTS WITH DIFFERENT VARIETIES OF OATS — The Kron variety holds the first place with a yield of 21.13 cwt. of grain per acre; next comes Probsteler with 20.08 cwt. The two new Swedish hybrids, Orion and Björn, specially designed for the northern districts gave, in 1916, a yield slightly higher than that of Tysk Mosshafre (a German oat for peaty soils).

	Straw per acre Cwt.	Grain per acre Cwt.	Weight per quarter lbs.	Weight of 1000 grains gms.	Percentage of grain	Number of days from sowing to appearance of inflorescences	Duration of growing period days
<i>White Wheats:</i>							
Kron . . . . .	43.51	21.22	303.1	34.5	73.7	93	116
Probsteler . . . . .	43.60	20.08	296.0	34.6	73.6	92	116
<i>Black Wheats:</i>							
Tysk Mosshafre . . . . .	37.87	18.97	311.4	30.5	73.1	62	113
Orion . . . . .	41.76	19.42	324.2	34.5	73.0	84	117
Björn . . . . .	41.95	19.38	324.8	30.1	74.2	86	117

154 - Increased Production of Cereals in Sweden. — See No. 143 of this Review.

[152-154]

**The Colour Classification of Wheat.** — HAYES, H. K., BAILEY, C. H., ARMY, A. C. and OLSON, P. J. (Committee of the Minnesota Section of the American Society of Agronomy), in the *Journal of the American Society of Agronomy*, Vol. **IX**, No. 6, pp. 281-284. Washington, D. C., September, 1917.

The colour of wheat is due to the joint effect of two factors: — 1) The presence or absence of a brownish-red or orange-yellow pigment in the bran layer; 2) the physical condition of the endosperm cells. These latter may be corneous or starchy, according to the density of the cell contents or the relative amount of space occupied by air cavities or vacuoles. The confusion which has arisen with regard to the colour classification of wheat is probably due to the use of a single term to describe the combined visual effect of these two characters.

The presence or absence of a red pigment in the bran layer is of little importance in indicating milling value; but the density of the endosperm is of great importance. Pigmentation is definitely inherited and varies under widely varying environmental conditions. Although somewhat modified by climatic conditions, the intensity of pigmentation is a hereditary character. With the same degree of pigmentation, a starchier kernel has a lighter appearance than a corneous kernel, but there is no difficulty in distinguishing a starchy pigmented kernel from a starchy white kernel.

If inheritance be regarded as a characteristic manner of reacting to a certain environment, it may be said that the physical condition, whether corneous or starchy, is an inherited character. This, however, does not apply to the density of the endosperm, which is very dependent upon environmental conditions, a fact which must be borne in mind in classification in view of its relation to milling qualities.

The authors, therefore, propose the following classification: —

Two columns are necessary: 1) *Pigmentation*; 2) *Physical condition or density*.

Under *pigmentation* it is proposed to use the term "red" to show the presence of a brownish-red pigment in the bran layer. This is to be modified by the term "light" when the degree of pigmentation is less than is usual in red wheats. Although the pigment may not be entirely absent from the bran layer of the so-called "white wheats", it is so nearly so that the term "white" is proposed in classifying them. It is recognised that a corneous kernel with a non-pigmented bran layer will not appear perfectly white. The colour of the bran layer is not affected by the density of the endosperm, although the visual appearance due to the two factors is influenced by the relative endosperm density.

Under *physical condition or density* are proposed 4 terms to denote the various gradations of endosperm density: 1) corneous; 2) sub-corneous; 3) sub-starchy; 4) starchy.

In the first group, *corneous*, would be included only the uniformly corneous sample.

The second group, *sub-corneous*, would include samples whose kernels approach either of the following conditions or a combination of both: —

a) samples containing  $\frac{2}{3}$  corneous kernels and  $\frac{1}{3}$  starchy or sub-starchy kernels; b) samples in which nearly all the kernels approach the corneous group, the greater part having only a small percentage of starchy endosperm.

The third group, *sub-starchy*, would consist of kernels  $\frac{2}{3}$  of which are starchy and  $\frac{1}{3}$  corneous, or kernels which contain a small amount of corneous matter with the larger part of the endosperm starchy or a combination of these two conditions.

The fourth group would be limited to uniformly starchy material.

It is recognised that samples intermediate to two of these groups are often found; in such a case they must be placed in the group they most closely resemble; the signs + and - may be used to show they are slightly above or below the average of the group in which they are placed.

156 - The Effect of Sodium Nitrate Applied at Different Stages of Growth on the Yield, Composition and Quality of Wheat. — DAVIDSON, J. and LE CLERC, J. A. (Plant Chemical Laboratory of the Bureau of Chemistry, U. S. Department of Agriculture), *Journal of the American Society of Agronomy*, Vol. IX, No. 4, pp. 143-151. Washington, D. C., April, 1917.

LE CLERC and LEAVITT (1) have shown that the variation in nitrogen content of wheat is independent of the original nitrogen content of the seed used. This conclusion is confirmed by other work which has proved that the soil is a minor factor in this variation, so that it appears that the principal factor, within the limits of these experiments, is climate. It remains to be found which factor, or combination of factors, of climate (rainfall, sunshine, altitude, temperature) are the principal causes of such variation and whether climate affects the metabolism of the plant directly, or indirectly by modifying the amount of plant food in the soil.

The work described in this paper was undertaken to study this question. It was thought that climate might be the cause of the variation of available nitrates at different stages of growth and it therefore seemed advisable to study the effect of the application of sodium nitrate at these different stages. The experimental plots measured 1 square rod each and the nitrate was applied, either in solution or in the solid state, at the rate of 320 lbs. per acre in 1, 2 and 3 lots at the following periods: — 1) when the crop was about 2 inches high; 2) at heading; 3) milk stage.

The results show, above all, that the addition of sodium nitrate at the early stages of growth stimulates the vegetative growth and, consequently, increases the yield. Though the presence of sodium nitrate at the time of heading gives a better quality grain as regards colour and protein content, it does not affect the vegetative growth. At the milk stage, sodium nitrate has no effect on the yield, quality or protein content of the grain. The same results were obtained whether the nitrate was applied in solution or in the solid state, except during the first stage, when the use of nitrate

(1) LE CLERC, J. A. and LEAVITT, S., *Tribunal Experiments on the Influence of Environment on the Composition of Wheat*, in U. S. Dept. of Agr., Bureau of Chemistry, Bull. 18 pp. 18. 1910. (Author).

tion gave higher yields, probably on account of the better distribution of the fertiliser in this form.

The experiments also confirmed the negative correlation between the nitrogen content and yellow colour of the grain; potassium chloride alone appears to increase this colour, but does not effect either the vegetative growth or the chemical composition of the grain.

**Experiments with Wheats at Verrières, Seine-et-Oise, France.** — De VILMORIN JACQUES, in *Comptes Rendus des Séances de l'Académie d'Agriculture de France*, 5 S. II No 38, pp. 1077-1085. Paris, December 5, 1917.

In this paper are given the results of experiments with wheats begun in 1917 at Verrières by M. PHILIPPE DE VILMORIN, and continued after death by the author.

**I. — SPRING WHEATS.** — The following seven varieties were studied in 1917: *Aurore*, *White Fife*, *Manitoba*, *Red Fife*, *Kolben*, *Mars rouge sans barbes*, *Marquis*.

The *Manitoba* wheat used for comparison was from the old VILMORIN stock, received from the Corbeil mills in 1900, and grown ever since at Verrières.

The experiments were divided into two parts:

1) *Aurore*, *Manitoba*, *Red Fife*, *Marquis* and *Kolben* were compared. These wheats were classified as follows: —

Earliness	Yield
1st. — <i>Aurore</i>	1st. — <i>Aurore</i> with 40.20 lbs. per 120 sq. yds.
2nd. — <i>Marquis</i>	2nd. — <i>Kolben</i> " 31.46 " " " "
3rd. — <i>Manitoba</i>	3rd. — <i>Marquis</i> " 30.25 " " " "
4th. — <i>Kolben</i>	4th. — <i>Manitoba</i> " 23.98 " " " "

In the 1917 yield tests *Kolben* took a good place, much higher than it had held previously.

2) The number of days elapsing between the date of sowing and that of harvesting were:

Sown on March 1.	Sown on March 15
<i>Aurore</i> . . . . . 148 days	<i>Marquis</i> (received and sown on the 20th. only) . . . . . 136 days
<i>Mars rouge sans barbes</i> . . . . . 156 "	<i>Aurore</i> . . . . . 138 "
<i>Manitoba</i> . . . . . 150 "	<i>Mars rouge sans barbes</i> . . . . . 144 "
<i>White Fife</i> . . . . . 162 "	<i>Manitoba</i> . . . . . 147 "
<i>Red Fife</i> . . . . . 162 "	<i>White Fife</i> . . . . . 147 "
<i>Kolben</i> . . . . . 169 "	<i>Red Fife</i> . . . . . 151 "
	<i>Kolben</i> . . . . . 155 "
Sown on April 1.	Sown on April 15.
<i>Aurore</i> . . . . . 120 days	<i>Aurore</i> . . . . . 114 days
<i>Marquis</i> . . . . . 131 "	<i>Marquis</i> . . . . . 114 "
<i>Mars rouge sans barbes</i> . . . . . 135 "	<i>Mars rouge sans barbes</i> . . . . . 116 "
<i>Manitoba</i> . . . . . 138 "	<i>Manitoba</i> . . . . . 116 "
<i>Kolben</i> . . . . . 138 "	<i>White Fife</i> . . . . . 116 "
<i>White Fife</i> . . . . . 114 "	<i>Red Fife</i> . . . . . 120 "
<i>Red Fife</i> . . . . . 144 "	<i>Kolben</i> . . . . . 120 "



*Aurore* wheat leads in every respect, being very closely followed by *Marquis* wheat.

*Aurore* wheat. — This wheat is of Australian origin, a hybrid of the *Ja* cinthe and *Ladoga* varieties obtained in Australia. It was imported in 1892 in the *VILMORIN* collection. One plot of *Aurore*, sown on May 1st, was harvested on July 31st., after exactly 3 months, with a yield of 1177 lbs for 25 ares (17 cwt. per acre), in medium soil, with average cultural methods. Sown during the first days of March, *Aurore* gave, in 1916, a fine yield of over 26 cwt. per acre. In 1917, however, though sown, under bad conditions, it only gave a yield of 17 ½ cwt. per acre. *Aurore* wheat is an excellent spring wheat for France.

*Marquis* wheat. — This variety, obtained in Canada by DR. CH. SANDERS, is rapidly taking the place of all other varieties in that country. Its earliness, surpassed by no other wheat in America, and which, in the experiments in question, is very near that of *Aurore*, gives it a great value. The advantage it has in being a selected wheat, and not mixed, like *Manitoba* is very appreciable. It would be useful to grow it in France on account of its earliness and yield.

*Mars Rouge sans barbes* comes after *Marquis*, followed immediately by the series *Fife*, alias *Manitoba*.

## II. — RESISTANCE TO COLD OF THE DIFFERENT VARIETIES OF WHEAT.

— Observations on this point were made in the annual experiment on winter yields at Verrières. In this district the frosts continued almost without interruption from January 20th. to February 15th., sometimes reaching — 16° C.

### Classification in 1917 according to resistance to cold.

#### 1. Varieties resisting well or hardly suffering.

- 1) *Rouge d'Athirch* (completely immune)
- 2) *Teverson* (resisted well, none lost)
- 3) *Dattel* (id.).
- 4) *Automne rouge barbu* (id.).
- 5) *Nouvelle de Lausanne* (id.).
- 6) *Épeautre blanc sans barbe* (id.).
- 7) *Perte du Nuïsement* (a few plants only lost).
- 8) *Victoria d'Automne* (id.).
- 9) *Blanc des Flandres* (id.).
- 10) *Blé-Seigle* (id.).
- 11) *Crépi* (id.).
- 12) *Gros bleu* (id.).
- 13) *Briquet jaune* (id.).
- 14) *Lamed* (id.).
- 15) *Rouge d'Ecosse* (id.).
- 16) *Browick* (id.).

#### 2. Varieties suffering but little.

- 17) *Grosse Tête* (barely 1/3 lost)
- 18) *Massy* (id.).
- 19) *Teverson à épi blanc* (id.).
- 20) *Chiddam d'Automne à épi rouge* (id.).
- 21) *Little Joss* (id.).
- 22) *Trésor* (1/4 lost).
- 23) *Blanc à paille raide* (id.).
- 24) *Blé Hybride No. 115* (lost 1/3).
- 25) *Blé Hybride No. 104* (id.).
- 26) *Blé Manitoba* (from Gollischütz lost).
- 27) *Mars de Suède rouge barbu* (1/3 lost).
- 28) *Géant du Milanais* (id.).

3. *Varieties suffering.*

- ) Roseau (1/2 lost).
- ) Bordeaux (id.).
- ) Bon Fermier (id.).
- ) Japhet (id.).
- ) Champlan (id.).
- ) Blé Hybride No. 119 (id.).
- ) Blé Hybride No. 120 (id.).
- ) Haïf Inversable (id.).
- ) Blé Hybride No. 131 (id.).
- ) Blé Hybride No. 105 (id.).

4. *Varieties suffering badly.*

- 38) Noé (1/3 frost bitten).
- 39) Bordier (3/4 frost bitten).
- 40) Allés (id.).
- 41) Blé Hybride No. 118 (id.).
- 41-a) Saumur d'automne (id.).
- 42) Rouge de Saint-Laui (id.).
- 43) Riéti (id.).
- 44) Odessa sans barbes (id.).
- 45) Engrain commun (id.).
- 46) Barbu a gros grain (7/10 frost bitten)
- 47) Cuzaux (4/9 frost bitten).

5. *Varieties completely or almost completely frost bitten.*

- |  |  |
|--|--|
| Rouge polifugue barbu (suffered very badly).             | 61) Saumur de Mars (completely frost bitten).        |
| Châdam blanc de Mars (id.).                              | 62) Blé Hybride de printemps No. 192 (id.).          |
| Palminiers (almost entirely frost bitten).               | 63) Blé Hybride de printemps No. 193 (id.).          |
| Touzelte rouge de Provence (id.).                        | 64) Aurora (id.).                                    |
| Hérison sans barbes (id.).                               | 65) Mars barbu ordinaire (id.).                      |
| Mars rouge sans barbes (id.).                            | 66) Mars rouge barbu (id.).                          |
| Richelle blanche de Naples (a few plants only remained). | 67) Pikomelle noire de Nice (id.).                   |
| Gironde (id.).   | 68) Amidonnier blanc barbu (id.).                    |
| Blé Hybride de printemps No. 187 (id.).                  | 69) Amidonnier blanc anelire (Alvargon-zalez) (id.). |
| Pikomelle blanche (id.).                                 | 70) Miracle (id.).                                   |
| Sis-roned Poulard (id.).                                 | 71) Besouarka (id.).                                 |
| Poulard d'Australie (id.).                               | 72) Médiah (id.).                                    |
| Richelle blanche hative (id.).                           | 73) Polozne (id.).                                   |

The following results were obtained in experiments on "successive sowing", in which various hybrids were studied and many known varieties were used for comparison.

*Chi am winter wheat (white ears).*

- on October 20 (almost entirely frozen).
- on December 1 (resisted well).

*Blé des Allés.*

- on October 20 (almost entirely frost bitten).
- on December 1 (resisted well).

*Blé Aurora.*

- on October 20 (entirely frost bitten, except 3 plants).
- on December 1 (very badly attacked).

This last observation was made only out of curiosity and is of no practical value as spring wheats are never sown in autumn.

1 - **Wheat Growing in Tuscany:** — FERRARI P., in *L'Italia Agricola*, Year LIV, No. 11, pp. 385-389, Piacenza, November 15, 1917.

In Tuscany, the production of wheat, as such, has relatively little importance, for the topographical conditions of the province are more favorable for the cultivation of woody plants (vine, olive, etc.), so much so

that, in many localities, the total production of the farm does not suffice for the consumption of the farm family. On the other hand, Tuscany produces seed of one of the best wheat varieties ("gentil rosso") which when cultivated in the fertile plains of upper Italy, has considerably increased the unit production of this cereal.

Tuscany was the first region of Italy to improve the local varieties of wheat by careful selection, a process that has been practised since 1890.

Tuscan wheats are all soft varieties: —

"Gentil rosso": — most widely grown wheat in Tuscany; awnless; long, blond grain, tillers abundantly.

"Gentil bianco": — when mature, ear and grain are lighter colour than those of the previous variety; awnless; seed not so long as that of "gentil rosso"; good cropper, especially in hill regions (650 to 1300 ft.).

"Calbigia": — ear coloured like that of "gentil bianco"; grain reddish; this is why, in several localities, the name "calbigia" is used as a synonym of "gentile", and local varieties are often called "calbigia bianca" or "calbigia rossa", according to the colour of the grain.

"Mazzocchio": — round ear, with long, stiff awns; does not ripen so well as the preceding varieties, and is best suited to hill regions; is less affected by shading by the olive and other trees, and is little liable to lodging; full, reddish grain, giving a good yield of flour that makes excellent bread.

Among other local varieties are: "grano rosso" (red wheat) and the bearded "cascola", chiefly grown in the provinces of Pisa and Grosseto; "civittella" with a long, white, bearded ear; "andriolo", bearded, suited for hill regions. All these varieties are of secondary importance compared with "gentil rosso", which may be considered as the typical wheat of the greater part of Tuscany.

Amongst introduced varieties, *Rieti wheat* is grown in level regions where the crop is liable to rust. Some trials have been made of the hybrid *variable de Vilmorin* (Vilmorin's non-lodging hybrid) wheat in flat districts where the shade produced by trees is harmful.

On the author's suggestion the "R. Accademia dei Georgofili" of Florence opened, in 1890, a competition for bonuses for the selection of wheat seed, in order to improve local varieties. Owing to the good results of this competition, another was organised in 1895, always limited to local varieties. These competitions showed up the value of the "gentil rosso" and "gentil bianco" varieties, especially of the former. Many competitors showed that, by methodic seed selection, were obtained uniform characters, greater tillering power, a longer ear, a greater number of fertile spikelets, and, in consequence, a greater unit yield. This is why many farmers of the Val d'Arno (province of Florence), among those who had won prizes at the competition, commenced the large scale production of "gentil rosso" for seed. In 1905, the Florentine "Consorzio agrario" commenced the sale in Tuscany and upper Italy, where "gentil rosso" was very successful. Afterwards, many farms sold "gentil rosso" seed wheat direct to the "Consorzi agrari" of Venetia, Lombardy and Emilia, the re-

natives of which visited the crops before the harvest to ascertain their uniformity. Then the "Istituto per le sementi" was founded to deal particularly with the provision of and preparatory work for seed wheat, the fusion of which was greatly helped by the "Federazione italiana dei Conzi agrari".

In 1913 it was calculated that, in 18 provinces of Piedmont, Lombardy, Venetia and Emilia, the wheat "gentil rosso" was grown on 86 050 acres 35 % of the total area under wheat (see *Il frumento in Italia*, Ministero Agricoltura, Industria e Commercio, Ufficio di Statistica Agraria, pp. 33. and 34, 1914).

Allowing that the locally produced seed can be used for 5 years, about 600 quintals of the original wheat seed must be imported every year.

The example given by the "R. Accademia dei Georgofili" of Florence has been followed by the Bologna Agricultural Society, the R. Academy of Agriculture of Turin, the Treviso Agricultural Association, the Agricultural Committees of Catania and Pisa, the "Cattedra Ambulante di Agricoltura" of Piacenza, etc.

9 - "Kanred", a New Wheat for Kansas. — JARDINE, W. M., in the *Journal of the American Society of Agronomy*, Vol. IX, No. 6, pp. 257-266. Washington, D. C., September, 1917.

ORIGIN. — The new wheat, called Kanred, is the product of a single seed selected in 1906 from Crimean (No. 1435 of the Office of Cereal Investigations, U. S. Department of Agriculture) by the Department of Agronomy of the Kansas State Agricultural College. In the autumn of 1906, 4 selected heads were sown, and 451 were harvested in the following season. These and 79 other selections were sown in single rows alternating with Kharkof wheat for purposes of comparison. In 1908, 533 selections were harvested, 122 of which were chosen for increase. In the autumn 1908 of each of these were sown with alternate rows of Kharkof. In 1909, selections were harvested, sown in rows as before, and, in 1910 the harvest, together with 100 other strains, was passed over to the Agronomy Department for further trial. From 1911 to 1916 several of the most promising selections, including Kanred, were grown in pots. From 1914 onwards Kanred was grown at the sub-station at Hays, Kansas, and in comparative tests with farmers throughout the hard winter-wheat belt. Since 1915 it has been grown at the sub-stations at Colby and Garden City, Kansas. Milling and baking tests and chemical analyses of the most promising strains have been made each year since 1912.

CHARACTERISTICS. — Hard winter-wheat, bearded, with whitish, glaucous glumes and reddish grain of the well-known Crimean or Turkey type. In habit of growth and general appearance the plant and grain cannot be distinguished from Turkey and Kharkof unless it be in minute botanical differences which have not been determined. It usually heads and matures somewhat earlier than Turkey and Kharkof, but this difference is not sufficiently constant for identification.

*Average yields and other Agronomic Data of Kanred,  
Turkey and Kharkof Wheats at Manhattan, Kansas from 1911 to 1914*

Variety	Yield in bushels per acre	Date of heading	Date of ripening	Weight in the per bushel
Kanred . . . . .	31.1	May 21.8	June 19	59.2
Turkey . . . . .	26.5	May 22.8	June 20.8	59.5
Kharkof . . . . .	25.9	May 23.1	June 21.2	58.3

In the tests carried out at the three above-mentioned sub-stations in cooperation with farmers, Kanred always surpassed, in unit yields, the varieties compared with it, ripened before or at the same time as the other wheats, and appeared to bear the winter better.

*Average Results of Milling and Baking Tests made at Manhattan  
from 1912 to 1915.*

	Grain			Flour			Absorption, cc.	Maximum expansion, cc.	Open rise cm.	Loaf volume, cc.	Color	Taste %	Weight gm.	Wet gluten %
	Protein %	Moisture %	Yield of flour %	Protein %	Moisture %	Moisture %								
Kanred . . . . .	17.59	10.85	64.13	16.19	12.95	59.6	21.50	5.6	1937	92.7	93.2	521	54.34	13.5
Kharkof . . . . .	15.84	11.63	63.26	14.32	13.18	60.7	21.60	4.9	1877	92.5	93.0	529	45.90	13.5

160 - **Maize in Madagascar.** — REYNIER, F., in *Revue Agricole et Vétérinaire de Madagascar et Dépendances*, Year II, No. 13, pp. 9-16. Tananarive, November, 1917.

Maize does very well at all altitudes in the island of Madagascar, where it is cultivated throughout the year. In certain dry districts, if the necessary water is supplied by irrigation, maize may be had in all its stages — sight often seen in the well-irrigated valleys of the south-west. It is, however, chiefly grown along the western coast from November, when it is sown after the first rains, till March, when it is harvested. Two, or even three, harvests are possible all over the island, one being without irrigation. The province of Tuléar alone could produce 50 000 metric tons of grain exclusive of the amount necessary for local consumption.

Before the war it was not possible to grow maize for export in Madagascar, owing to the cost of transport to the large European ports, freight being quite prohibitive. As a result of the war, the production of maize has decreased in the belligerent countries and increased in those neutral countries which could grow it more largely; as the demand is in excess of the supply, there is scope for newcomers on the market. These facts together with the increased prices and levelling of freight on all shipping lines, completely change the position of Madagascar and place it in the best possible conditions for supplying profitably at least all the maize imported by France, which, in normal times, reached the round figure of 500 000 metric tons, but which, at present, is being imported in much larger quantities. Emphasis is laid on the necessity of organisation among the farmers to carry out this scheme.

1 - **Transplanting in the Control of "Wild" Rice in Italy.** — MARCARELLI, B., in *Il Giornale di Riscoltura*, Year VII, No. 21, pp. 260-264. Vercelli, November 15, 1917.

In the Italian rice-fields the name "riso-crodo" or "riso selvatico" (wild rice) is given to plants forming sub-varieties, now become wild, of the oldest variety of rice cultivated. They are characterised by: — vigorous growth from the beginning; the ease with which the grain drops from the panicles with the slightest contact; the vitality of the grain lasting many years. They are placed in two principal categories: — 1) with white panicles; 2) with red panicles. The first category, which is the more common and more dangerous because of the ease with which the grain falls when ripe, includes plants of medium growth, with white nodes, rather compact large panicles with round, bearded grain of a silvery white after earing and during flowering, but yellowish when ripe. The plants of the second category are less dangerous, because less common with little tendency to remain wild; they are straight, high, with black nodes, slightly hulled or bare grain, long and covered with a yellowish-red down. Since a few years there has spread more extensively another sub-variety, similar to that of the second category in size, but with long-bearded, black panicles, whose grain falls very easily and spreads quickly.

It is impossible to exterminate these plants by uprooting ("rimonde"), because, while green, they resemble cultivated rice very closely, and, after earing, they are very similar to "Ostiglia" and "Lencino" rice. It is for this reason that they are the cause of serious loss in permanent rice fields, a loss exceeding that caused by the most common weeds, sometimes affecting 70 to 80 % of the yield. Moreover the few grains which pass into the crop decrease its value, for they break easily during threshing and, after polishing, have reddish lines.

When a rice field infested with "wild" rice has been under rotation for one or two years with meadow grass or wheat, and the turn of rice comes round again, the "wild" rice appears again, stronger than ever, because a large number of grains remain alive in the soil.

The methods recommended for the control of "wild" rice are. — Turning poultry on to the rice field immediately after the harvest; burning the stubble whenever and wherever possible; deep winter and spring ploughing; careful and continuous weeding of the field; collecting the panicles immediately after flowering; sowing in lines so that all plants growing in the spaces may be pulled up.

Nevertheless, all these methods are not always efficient for fighting or preventing the spread of the plants; but they disappear easily and quickly the transplantation method is adopted. By this method, between two harvests of rice, may be obtained one of colza, crimson clover, hay or rye. The "wild" rice seeds which have shot up during this intermediate harvest are taken with great difficulty on account of the insufficient winter-spring temperature. The basis of this method is as follows: as soon as transplantation has been carried out, the level of the water must be raised from 5 to 30 cm., so that the "wild" rice remains too long out of contact with the air and rots. A few plants which survive are soon outstripped and overcome by the cultivated rice, and rapidly turn yellow and die.

The life cycle of "wild" rice is much affected, and completely stopped after two or three years of the transplantation method, which is the only efficacious one for eradicating this weed from new rice fields, or old or mountain ones.

162 - Tuber and Root Cultivation Trials made in 1916 at the Agricultural Station of Flahult, Sweden. — VON FEILITZEN, HJALMAR, in *Scenska Mosskulturförenings Tidskrift*, Year XXXI, No. 6; pp. 469-486. Jönköping, 1917.

1) COMPARATIVE EXPERIMENTS WITH 35 VARIETIES OF POTATOES. — An average yield of 6.36 tons per acre was obtained, with a maximum of 11.15 and 10.35 tons per acre for Grahms Non Plus Ultra and the English potato, The Factor, respectively. The percentage of small tubers was fairly high — 20.7 % — as a result of the early autumn frosts which prevented full growth. In comparison with the starch percentages of 1915 and 1914 (15.4 and 15.1 %), that of 1916 was low, an average of 13.15 %, with a maximum of 14.56 and 14.18 % respectively for Makalös and Non Plus Ultra. The starch yield per acre was 3 569 lbs. for Non Plus Ultra, 3 186 lbs. for Juvel, 3 093 lbs. for Harbinger, and 3 038 lbs. for The Factor.

2) Root Crops. — Turnips lead with 27.87 tons per acre (Weibel Bortfelder and Skalöf Bortfelder); then come kohlrabi, with 9.15 tons mangolds (Ovåle des Barres), with 8.55 tons, and, lastly, carrots (Charpion), with 4.77 tons per acre.

163 - The Cultivation of Alfalfa in the Oasis of Tripoli. — MAZZOCCHI-ALEMANNI, NAU in *R. Ufficio agrario della Tripolitania, La coltivazione dell'erba medica nell'asi tripolitana (Istruzioni pratiche agli agricoltori locali)*, Istruzione No. 1, pp. 18. Italian text — 1917 + pp. 10. Arab text + 1 coloured plate. Tripoli, 1917.

Alfalfa is undoubtedly the most important native irrigated herbaceous crop of the Tripolitan oasis, often it is the only one, and, at any rate, the principal fodder of the draught animals, who usually eat it green.

The high yields obtained from alfalfa locally, far surpassing those of the best Italian irrigated fields, the good quality of the fodder, its high price, the absence or lack of other foods for livestock, and the absolute necessity for the native farmer to have an animal employed permanently on a certain kind of work, especially drawing water from the wells, are all factors which prompt him to give as much attention as possible to this crop.

In normal times preference is given to alfalfa (native name: "sals") rather than barley, which is grown on the steppes round the oasis, or reared from the interior. The production of seed for the market is very limited, and its price very high. In 1917 the Royal Agricultural Office started to distribute seed free of charge, and, to improve the crop, issued practical rules (given in the paper under review) drawn up from observations made in the best alfalfa fields of the district.

The soil of the Tripolitan oasis is very well suited to the growing of alfalfa so long as it is well cultivated (deep and careful hoeing, weeding) and manured with: — 398.25 cwt. of manure; 20 cwt. of wood ash; 3.98 to 4.76 cwt. of calcium sulphate; 3.18 cwt. of superphosphate per acre. After harrow down the soil, a network of small irrigation canals is constructed according

the excellent native system, which consists of a series of main canals (usually of earth, rarely of stonework), arranged like fish-bones, and a certain number of secondary canals, also of earth, distributed over the whole area to be irrigated. The ground between two of these secondary canals is divided into a double row of plots ("gedauei"; *gedula* in the singular) measuring from 2 to 6  $\frac{1}{2}$  square yards, flooded separately by the water from the main secondary canals, each of which feeds a double row of plots, usually losenge shaped. Its well to surround the alfalfa field by hedges in order to protect it against the winds.

Local seed must be used. Repeated experiments with Italian and Tunisian seed always gave very bad results. There are two strains of native alfalfa: — "chobbesi" and "nefèh". The first gives higher yields and has larger leaves; the second has smaller leaves and lower yields. The most famed oasis localities for the production of good seed are Tadjourah and el Aïoun (Menschiab). The seed from the former is excellent in all soils which have soft water; those from the latter are particularly suited to soil irrigated with slightly brackish water. The best time for sowing is between March and May. Alfalfa is also sown from October to November at the same time as barley. It is sown either in lines, in holes containing 3 or 4 seeds, or broadcast. In the last case, sowing must be followed by hoeing, and always by abundant irrigation.

Ten to fifteen days are allowed to elapse between the first and second irrigation, so as to allow the roots to penetrate deeper. The normal duration of irrigation is from 5 to 6 days during the hot season, and from 10 to 12 days, or even more, during winter. A depth of from 30 to 50 mm. of water is given at each irrigation. Weeding is very important. Manure is not usually given during the first year, but the following years liquid manure is added to the irrigation water. The first cutting is made from 42 to 48 days after sowing; the others follow each other at intervals of from 20 to 25 days in summer, and from 30 to 40 days during the cool season. Good irrigated alfalfa fields will give at least 8 cuttings a year, normally 10, and sometimes even 12. Experiments carried out by the author gave yields of 8  $\frac{1}{2}$  tons of grass per acre, equal to 22  $\frac{1}{4}$  tons of hay. In special cases higher yields may be obtained. As a rule alfalfa is not dried, but fed green. In some times the truss gathered on one "gedula" has an average value of 4d.

The seed is collected only in the third year, which is usually the last. After alfalfa any crop may be grown except pepper.

**DISEASES AND PESTS.** — The only cryptogamic disease observed so far is leaf rust (*Uromyces striatus*), which, however, has never attacked the fields to such an extent as to compromise the crop or to make curative measures indispensable. As a protection against Aphids it is advisable to spread fine ash and irrigate less, or else cut before maturity. In 1916 the presence of *Cuscuta* was observed, and again in 1917. It seems to have been introduced into the oasis by the use of stable manure from the army, where hay from Italy is used.



- 164 - An Annual Variety of *Melilotus alba*. — CÖG, H. S., in the *Journal of the American Society of Agronomy*, Vol. IX, No. 8, pp. 380-382. Washington, November 20, 1917.

This paper is a contribution from the Office of Forage-Crop Investigations, Bureau of Plant Industry, U. S. Department of Agriculture. *Melilotus alba* is a biennial plant. In the spring of 1916 *Melilotus* seed from various districts was sown at Redfield, S. Dakota and Fargo, N. Dakota. In these two districts, seed from Alabama gave about 5 % of plants which flowered and matured seed during the first year; these plants did not differ, in most respects, from the typical biennials, but they all died during the following winter. The principal difference between the plants which flowered the first year and the biennial plants lies in the root; that of the former is a typical taproot with no enlargement at the crown and no crown buds; that of the latter normally possesses these characters. On the 27th. January, 1917, 275 seeds of the annual plants were sown in pots in a greenhouse; plants were obtained which, by May 25th., measured 4.5 to 5.5 feet, and were in flower.

The white-flowered annual variety may very likely be found in other districts of the south of the United States than those mentioned. It would probably be of great economic value as a winter crop in the south of the Gulf States, and in the centre and south of the United States as a summer hay crop and for green manure.

The acreage under *M. alba* in the United States is rapidly increasing, the most serious objection is the difficulty of eradicating it by autumn ploughing. This difficulty may be overcome by using the annual variety.

- 165 - The *Eragrostis* of the Argentine and Uruguay: Their Value as Fodder Plants. — GIROLA, CARLOS D., in *Boletín del Ministerio de Agricultura de La Plata* (Extracto), pp. 20, figs 5. Buenos Aires, 1917.

This paper is a summary of the various works aiming at making known the species of *Eragrostis* in the Argentine and neighbouring countries especially with respect to their fodder and agricultural value.

The following species are included in the herbarium of the Argentine Ministry of Agriculture, or described by various authors for the Argentine or for Uruguay: —

*Eragrostis airoides* — *atrovirens* — *bahiensis* — *brasiliensis* — *brasiliensis-calotheca* — *capillaris* — *ciliaris* — *diplachnoides* — *elegans* — *Eragrostis* — *expansa* — *flaccida* — *hypnoides* — *interrupta* — *lindmanni* — *longifolia* — *lugens* — *major* — *megastachya* — *mexicana* — *microstachya* — *minor* — *Neesii* — *neomexicana* — *nigricans* — *orthoclada* — *pilosa* — *plana* — *poaeoides* — *polytricha* — *psammodes* — *purpurascens* — *refuscens* — *repens* — *retinens* — *rosea* — *seminuda* — *striata* — *superba* — *triflora* — *trichosperma* — *uniolae* — *verticillata* — *virescens*.

These species are found over a large area; the most common are *pilosa* and *E. lugens*, valuable fodder plants in ploughed land. They resist the most diverse climatic conditions, adapt themselves to all soils, but prefer clean ones, profit much from fertilisers, especially lime and phosphate as was proved experimentally by the author. They are propagated by seed. As they do not grow very thickly they yield better when mixed

the other Gramineae and with Legumineae. The earliest are *E. lugens* and *E. pilosa*, followed by *E. major*, *E. poaeoides*, *E. mexicana* and *E. mesostachya*; the others are less tender and, consequently, late. They are better suited to pasture than to hay, partly because they bear being grazed very well. The most tender, and, therefore, the most valued varieties, give an average yield of 2.58 tons of grass per acre, which is reduced to 0.79 tons of hay (some do not give half this yield); those which grow best yield from 2.78 to 3.18 tons of grass per acre, giving from 0.79 to 0.99 tons of hay.

Analyses made in the Laboratory of Agricultural Chemistry of the Ministry of Agriculture (Buenos Aires) gave the results shown in the appended table. The narrow food ratio of the Argentine *Eragrostis* hay, which shows them to be superior to natural meadow hay and ray grass hay, explains the preference cattle show for them.

*Analyses of Argentine Eragrostis Hays.*

	<i>E. major</i>	<i>E. pilosa</i>	Average for the two varieties	Average for the two varieties expressed as dry matter
moisture (10-105° C) . . . . .	16.08	17.34	16.71	—
dry matter . . . . .	83.92	82.66	83.29	100
ash . . . . .	11.92	9.46	10.69	12.83
crude protein . . . . .	11.94	12.92	12.43	14.92
total nitrogen . . . . .	1.91	2.07	1.99	—
cellulose . . . . .	1.51	1.58	1.54	1.84
hydrocarbons . . . . .	36.00	34.00	35.63	42.77
crude fibre . . . . .	21.94	24.02	22.98	27.59
food ratio . . . . .	1:3	1:2.8	1:3	1:3

66 - **Important Range Plants: Their Life History and Forage Value.** — **SAMPSON, ARTHUR, W.,** in *U. S. Department of Agriculture, Bulletin No. 515*, pp. 63 + XVI plates. Washington, October 8, 1917.

The Forest Service of the United States Department of Agriculture, in cooperation with the Bureau of Plant Industry, undertook, in 1907, in the Willowa National Forest (north eastern Oregon) a study of the forage plants of grazing land in order to determine the habits, requirements and life history of the more important species. By observing bands of sheep while they grazed, the plants preferred by them were ascertained. The relative value of each variety was determined by studying its abundance, distribution, time of flowering, aggressiveness, reproduction (both vegetatively and by seed), seed habits, palatability, food value at various times during the grazing season and ability to withstand trampling.

Though the results are largely based on observations in the high mountains of Oregon at altitudes between 5 500 and 8 000 feet, they should be useful in revegetating the range throughout the West, since many of the species described are widely distributed, and the genera represented are among

*Moisture requirements of the species studied and the germinative power  
of their seed.*

Local name	Scientific Name	Soil-water content at time of excessive wetting	Class	germinating power of seed per cent
		%		%
High Huckleberry	<i>Vaccinium membranaceum</i>	—		—
Mountain Onion	<i>Allium validum</i>	14.0—16.0	A	37.0
Slender Reed Grass	<i>Cinna latifolia</i>	13.5—16.0		79.0—86.1
Tall Meadow Grass	<i>Panicularia nervata</i>	12.0—14.0		85.0
Tall Swamp Sedge	<i>Carex exsuccata</i>	22.5—24.0		15.2
Black Hair-grass	<i>Deschampsia atropurpurea</i>	12.5—14.7		—
False Hellebore	<i>Veratrum viride</i>	11.0—14.5		—
Fireweed	<i>Chamaenerion angustifolium</i>	8.2—11.5		16.5—28
Pine Willow	<i>Salix Scouleriana</i>	—		—
Porcupine Grass	<i>Stipa occidentalis</i>	9.5—11.5		27.0
Rush	<i>Juncus Martensianus</i>	—	B	—
Rush	<i>Juncus orthophyllus</i>	—		—
Small Wild Onion	<i>Allium fibrillum</i>	—		—
Smooth Wild Rye	<i>Elymus glaucus</i>	7.5—9.8		21.2
Tufted Hairgrass	<i>Deschampsia caespitosa</i>	11.5—14.5		20.0—50.0
Wild Celery	<i>Ligusticum oregonum</i>	8.0—9.5		2.0—11.5
Wild Onion	<i>Allium platyphyllum</i>	—		—
Wood Rush	<i>Juncoides parviflorum</i>	10.0—12.5		7.5
Butterweed	<i>Senecio triangularis</i>	11.5—14.0	A and B	18.0—26.0
Coneflower	<i>Rudbeckia occidentalis</i>	16.0—18.5		11.0—24.5
Marsh Pine Grass	<i>Calamagrostis canadensis</i>	11.0—14.0		59.5—86.5
Mountain Timothy	<i>Phleum alpinum</i>	14.0		58.2—76.0
Sheep Sedge	<i>Carex illota</i>	14.0		27.5
Big Bunch Grass	<i>Agropyron spicatum</i>	5.5—7.5		26.2
Blue Bunch Grass	<i>Festuca idahoensis</i>	—		11.0—21.0
Elk Grass	<i>Carex Geyeri</i>	6.5		6.0—32.0
Geranium	<i>Geranium viscosissimum</i>	—		29.4
Horsemint	<i>Agastache urticifolia</i>	—		16.0—38.5
Little Bluegrass	<i>Poa Sandbergii</i>	6.5—7.8		7.0—58.4
Little Needle Grass	<i>Stipa minor</i>	9.2—11.5		—
Mountain Bunch Grass	<i>Festuca viridula</i>	7.0—9.5		12.2
Mountain Dandelion	<i>Agoseris glauca</i>	8.0—10.0		29.0—41.0
Mountain June Grass	<i>Koeleria cristata</i>	10.0—13.5		14.0—16.0
Mountain Wheat Grass	<i>Agropyron violaceum</i>	6.0—7.5		85.5
Onion Grass	<i>Melica bella</i>	6.3—8.5	C	4.0
Pine Grass	<i>Calamagrostis Suksdorfii</i>	5.5—8.5		69.5
Red Bunch Grass	<i>Agropyron flexuosum</i>	—		—
Rush	<i>Juncus confusus</i>	—		—
Rush	<i>Juncus Parryi</i>	5.5—7.0		—
Salt Cheat	<i>Bromus hordeaceus</i>	5.5		63.3
Spiked Trisetum	<i>Trisetum spicatum</i>	7.5—9.5		19.5
Short-awned Bromegrass	<i>Bromus marginatus</i>	5.5—8.0		36.0—58.0
Tall Bluegrass	<i>Poa brachyglossa</i>	—		—
White Foxtail	<i>Stilium velutinum</i>	6.0—8.5		43.0—62.5
Woolly Weed	<i>Heracium cynoglossoides</i>	8.0—10.5		9.5—12.5
Yarrow	<i>Achillea lanulosa</i>	10.0—12.5		16.5—90.0
Alpine Redtop	<i>Agrostis Rossae</i>	7.0—8.5	B and C	29.0—41.0
Blue Beard Tongue	<i>Pentstemon procerus</i>	8.0—10.0		18.5
Skunkweed	<i>Polemonium pulcherrimum</i>	7.0—10.0		32.5—41.5
Slender Hairgrass	<i>Deschampsia elongata</i>	8.5—15.0		41.5—56.5
Wild Buckwheat	<i>Polygonum phytolaccaefolium</i>	8.0—10.0		3.0—15.5
Valerian	<i>Valeriana sitchensis</i>	7.0—8.5		21.5—26.0

be most important of those of the Western ranges. The bulletin gives a description and a natural size photograph of each important species.

The appended Table gives the relative water requirements of the most important plants studied. The relative ability of the various species to withstand drought was ascertained by determining the amount of water remaining in the soil when the plant had wilted to a point from which it could not recover. For artificial determinations the plants were dug up, with the roots undisturbed in their own soil, particular care being taken to run off as little of the root system as possible. The lump of soil was placed in a wire basket and put back into the hole made by digging up the plant. After the plant had regained its strength it was slightly raised in order to increase the rapidity of the drying process. For plants with deeply penetrating roots especially, the soil was sometimes dug away all around the plant, leaving in place only the central core of soil; when the plant had wilted completely the moisture was determined by taking two samples of the soil.

In order to compare habitat requirements, the species are grouped in three classes.

CLASS A. — Plants of high moisture requirements, living in saturated soil, such as open marshes, wet meadows and bogs.

CLASS B. — Plants of medium moisture requirement, in relatively heavy soil which is saturated during the early part of the season, but later contains a medium amount of water.

CLASS C. — Plants of low moisture requirement, in well-drained lands, on glades, and exposed situations.

The table shows about  $\frac{3}{4}$  ths. of the most valuable forage crops to be wet-land plants. The vegetation of wet lands is very luxuriant, but little appreciated by live stock and of low food value.

The data on the germinating capacity of the seeds (see Table) were obtained from the seed-testing laboratory of the United States Department of Agriculture.

In another table are given the time of flowering and that of the ripening of the seeds of 51 species for 3 consecutive years (1907, 1908, 1909). They show that the flowering period varies more than that of seed maturity. Species and conditions considered, the flower stalks are mainly produced between July 5th. and August 10th., and the seed matures between August 15th. and September 1st. These periods are influenced by physical factors, but far more so by the weakening of the vegetation due to overgrazing. The periods of flowering and ripening are thus retarded, and, in extreme cases, no flower stalks are produced, and the seed has little or no minative power.

- **Composition and Improvement of the South-Western Ranges of the United States.** — See No. 188 of this Review.

- **Influence of the Time of Cutting on the Amount and Composition of the Hay Produced.** — See No. 184 of this Review.

- 169 — "**Bate's Big Boll**", an American Variety of Cotton Tested in Sicily. PRESTIANNI, NUNZIO, in *Il Collivatore*, Year LXXII, No. 39, pp. 271-273. Casale Monf., October 30, 1917.

This paper gives the results of experiments carried out in Sicily since 1911 to find a variety well suited to the climate of the country and capable of yielding a product more abundant and of higher quality than that "cotone nostrale" (local cotton-plant), cultivated since remote times in the districts of Sciacca, Menfi and Ribera (Sicily).

Among the varieties tested, an American one, *Bate's Big Boll*, proved valuable and steps are being taken to increase its cultivation. In 1915 the production of staple in the district was 1,968 tons, in 1916, 3,936, and in 1917 it must have been 9.84 tons.

The characteristics of the variety are:

A vigorous, pyramid-shaped, bushy plant, with strong, dark red branches; in fresh, deep soil it reaches a height of from 23 ½ to 29 ½ inches and, on the average, in clay (non-irrigated) soils, a height of from 15 ¾ to 19 ½ inches. The leaves are rather large, of a deep green colour, with, the most, 3 oval acuminate lobes. The flowers are large and pink. The capsules are large, oval and round, with 4 to 5 cells and 32 to 34 twists staple. Ripening begins at the end of August and continues through October.

The average yield of unginned cotton in non-irrigated soils is from 6 to 7.16 cwt. per acre, the average yield of staple, from 38 to 39 % (33 % the most for local cotton).

The staple is fairly strongly attached to the seed, of a creamish white, not very lustrous, soft, of an average length of 27 to 29 mm., average resistance, homogenous. Its commercial value is much above that of the local plants.

- 170 — The *Ailanthus* (*Ailanthus glandulosa*) as a Paper-Yielding Plant. FEDERLE, V., in *La Nuova Agricoltura del Lazio*, Year V, No. 118, p. 345. Rome, December 1, 1917.

Some years ago (cf. *Il Collivatore*, No. 4, Jan. 24, 1909) the author as a result of experiments he made, mentioned the ailanthus as an excellent paper-yielding plant. It has the advantage of growing well everywhere, even in arid or purely rocky soils. By pollarding every three years and keeping the crown about 3 ¼ to 4 ¼ feet above the ground the author obtained about 200 lbs. of wood, which yielded 44 % of an easily bleached cellulose of a quality suitable for paper pulp. In 1909, the author estimated the value of this cellulose at 8*d.* per quintal of wet material; at the present day that value has increased greatly. One acre may contain from 240 to 280 trees, which, under normal market conditions, would give a profit of £ 8 per acre every three years.

PLANTS  
YIELDING OILS

- 171 — *Plukenetia conophora* ("Ngart"), a New Oil Plant of the Cameroons. See No. 138 of this Review.

**The Importance of Sweet Sorghum.** — PIÉDALLU, ANDRÉ, in *Comptes rendus des Séances de l'Académie d'Agriculture*, Vol. III, No. 38, pp. 1091-1095. Paris, December 5, 1917.

The author, after having shown how old is the cultivation of sweet sorghum (*Sorghum vulgare* Pers., var. *saccharatum*), describes his experiments with this plant, which he has grown near Paris, and which has done well in partly ripening its grain. When replanting the young plants he observed that the stems could be made to multiply by embedding or hilling up seedlings. By this method he was able to obtain strong plants with 15 stems instead of one, each of which produced a panicle and, in August, reached a height of 6 feet, some even exceeding 8 feet.

The uses to which all the different parts of the plant may be put are described.

**STEMS.** — In the climate of Paris the sugar content is only 4 to 5 % saccharose, without reducing sugars. According to the author, the unsalifiable reducing sugars of sweet sorghum are derived from the fermentation of the stems before treatment. In southern countries the sugar content is from 10 to 15% (1), with 2 to 4 % of reducing sugars. Some growers of the south cultivate a small quantity of sweet sorghum to strengthen the alcohol content of the wine.

**STEM RESIDUES.** — With the abundant fibre of the plant the author succeeded in producing a good paper. Analysis showed the stem to contain 15 to 17 % of fibre, or 29 440 lbs. of stripped stems gave 2 metric tons paper pulp per acre.

**LEAVES.** — A good food for rabbits, which the author fed on them, though poisoning of livestock has been reported from Egypt and the Indies caused by young or badly developed leaves containing a cyanogenic coside, dhurine (2).

**ROOTS.** — May be used for making alcohol.

**GRAIN.** — The author obtained about 100 gm. of grain per plant. In the south this yield may be 200 to 300 gm.; 100 gm. of grain give 72 gm. milled grain and 28 gm. of glumes.

The grain, which has a large reserve of starch, nitrogen and fat, gives brown flour with a good flavour which may be mixed with wheat flour for breadmaking (3). It may be used for feeding livestock.

**GLUMES.** — The author extracted a colouring matter, which he is studying. It is characterised by an orange-red colour in dilute solutions of strong acids, changing to violet with alkalis. A drop of this acid solution, added to water containing lime salts, gives a characteristic violet-pink lake. This colouring matter dyes wool and cotton grey with iron, violetgrey with copper, pinkish-violet with aluminium, more or less dark brown with alkaline bismuthate. It also dyes leather.

(1) AIMÉ, *Revue de l'Intendance*, Vol. XX, 1907; RIVIÈRE and LECQ, *Manuel pratique de l'Agriculture en Algérie*, (Author). — (2) JUMELLE, *Cultures coloniales*; BARRAL and FISER, *Dictionnaire de l'Agriculture* (Author). — (3) See B. 1015, No. 712. (Ed.)

173 - **Relation of the Transformation and Distribution of Soil Nitrogen to the Nutrition of Citrus Plants.** — MC BERN, J. G. (Physiologist, Soil Bacteriology and Plant Nutrition Investigations, Bureau of Plant Industry, U. S. Department of Agriculture). *Journal of Agricultural Research*, Vol. 1X, No. 7, pp. 183-252, 19 figs, XXX tables, bibliography of 14 publications. Washington, D. C., May 14, 1917.

The total nitrogen content of Californian Citrus lands\* is often low, but the quantity rendered assimilable through the natural processes of nitrification soon becomes inadequate to the needs of the plants unless it is maintained by the addition of commercial fertilisers, cover crops, manure, etc. On the other hand, the low rainfall of the districts in which citrus is grown, and the furrow system of irrigation practised, cause an uneven distribution of the nitrates in the soil, so that the solution of the nitrogen problem depends, not only on a knowledge of the factors influencing nitrification, but also on a knowledge of the forces controlling the distribution of nitrogen in the soil.

In order to solve these problems the author carried out at the Citrus Experiment Station grove at Riverside, Cal. a series of fertiliser and irrigation experiments with various quantities of ammoniacal and nitric nitrogen. He came to the following conclusions: —

A) FERTILISER. — 1) *Dried blood.* — Semi-arid soils often fail to nitrify dried blood when added in 1 % quantities, but invariably nitrify it when it is applied in quantities not exceeding those used ordinarily under field conditions. In the first case it often produces large accumulations of ammoniacal nitrogen which do not occur in the second. Semi-arid soils to which has been added 1 % of dried blood may lose, during a six weeks' incubation period, 50 % of the nitrogen added. As they frequently give off a strong ammoniacal smell, this loss is probably largely due to the volatilisation of the ammonia. Ammonification or nitrification studies on semiarid soils to which 1 % of dried blood is added are of doubtful value, and may lead to erroneous conclusions.

2) *Green manures.* — These, especially the legume varieties, nitrify very rapidly; half of the nitrogen contained in the green plant tissues may be converted into nitrates in 30 days. They also form a valuable source of energy for the non-symbiotic nitrogen-fixing organisms.

B) IRRIGATION. — 1) The furrow system of irrigation often causes a very unsatisfactory distribution of the soil nitrates. In many Citrus groves more than  $\frac{2}{3}$  rds. of the nitric nitrogen in the top 4 feet of soil are found in the surface 6 inches, in which, owing to the frequent cultivation, few feeding roots are found. This system also frequently causes the formation of nitre spots (1), where, if the soil is heavily fertilised, as much as 1 % of nitrogen as nitrates may be found by surface scrapings. These spots, or salt crusts, attributed by HILGARD to rapid nitrification of the organic matter of the soil, by HEADDEN to the fixation of atmospheric nitrogen by non-symbiotic bacteria, and by STEWART and PETERSON to the leaching of nitrates already in the soil, are, according to the author, rather to be attributed to the movement of water in the soil. Their characteristic brown colour depends on

(1) On the subject of nitre spots, see No. 129 of this Review. (Ed)

by factors, of which the most important appears to be the deliquescent character of the calcium nitrate.

When the furrow system of irrigation is used the fertiliser should be dug down somewhat deeper than the land is cultivated, thus placing food within reach of the feeding roots, because in the cultivated zone, irrigation tends to carry it away from these roots.

Much nitric nitrogen is lost from citrus lands by leaching. The most effective way of preventing this loss is by growing a winter cover crop.

2) Basin irrigation or overhead irrigation give a more satisfactory distribution of soil nitrates than the furrow system. The first seems to give better results when combined with a mulching system. However, the rapidity with which materials rich in nitrogen decay would seem to make it advisable to maintain a constant mulch with these materials, as the nitrate produced would probably be much in excess of the needs of the tree, much loss would result.

C) MOTTLED LEAF (1). — This disease is usually more marked in plots treated with large applications of commercial nitrogenous fertilisers, and is frequently (but not always) associated with a high nitric nitrogen content of the surface soil, a content which may be due to unfavourable conditions of the soil. An extremely variable supply of plant food and soil moisture may be an important factor in mottling. Mottled leaves usually have a higher moisture and nitrogen content than healthy leaves.

— **The Teak Trade of Siam.** — HANSEN, C. C., in *Commerce Reports*, No. 43, p. 275. Washington, D. C., 1917.

The teak forests of Siam are mainly located on the hillsides in the northern part of the Kingdom, some 500 miles from Bangkok. The teak trees are girdled and allowed to stand for several years before being felled, the logs are then dragged to the nearest stream and floated down. Reaching the sawmills at Bangkok, fully seasoned, in about 5 years from the time of girdling.

Teak logging is regulated by the Government, and only trees of 76.5 inches girth may be girdled. A Government counting station is located at Mampoh, a village situated on the River Chao Phya, 155 miles from Bangkok. The average number of teak logs arriving at this station each year is estimated at 100,000, and in addition about 20,000 logs, cut from the teak region adjoining Burma, are floated to Moulmien.

The total annual output of cut teak of all grades amounts to roughly 100,000 loads of 50 cubic feet, but of first quality the yearly output would probably reach only about half of the above estimate. On reaching the sawmills the logs are usually squared and the first-quality squares are graded according to the British Admiralty specifications, and are designated "European first class".

Siam's total exports of cut teak of all sorts for the fiscal year ended 31st, 1916, and for the preceding year consisted of : —

<sup>1</sup> See R. 1916, No. 1225. (Ed.)



Cut Teak	1914-15		1915-16	
	Tons	Value	Tons	Value
Squares . . . . .	34 422	\$ 1 338 535	30 980	\$ 1 124 195
Planks . . . . .	2 810	191 080	3 960	231 755
Shingles . . . . .	345	12 550	238	8 130
Log and butt ends . . . . .	857	24 175	1 051	36 620
Scantlings . . . . .	7 247	249 240	10 313	368 115
Other . . . . .	1 237	50 870	1 328	48 515
Total . . . . .	46 915	\$ 1 866 450	47 870	\$ 1 817 360

Of the exports during 1915-16, most of the teak squares went to India, Hongkong took nearly half the teak planks, the teak shingles went to Mauritius and Ceylon, most of the log and butt ends went to Hongkong, while scantlings were bought chiefly by India.

### LIVE STOCK AND BREEDING.

175 - Reaction Produced by the Intra-Palpebral Injection of Mallein. — LANFRANCHI, A., in *Il Moderno Zootetro*, Series V, Year VI, No. 9, pp. 197-202, fig. 1. 10-figs. September 30, 1917.

The diagnosis of glanders by means of the reaction produced by the intrapalpebral injection, proposed by the author in 1914, has been widely used, having been officially adopted for use in the Allied armies. As the author has applied it to a considerable number of cases, he has been able to make many observations, which have led him to the conclusions given below.

If, on account of numerous reactions produced by intra-palpebral injections or for other causes, sclerosis of the conjunctive tissue is observed in the lower eyelids, the mallein should be injected into the upper eyelid.

In the case of a negative intrapalpebral reaction in subjects already tested several times by this method, and for which the period of the intrapalpebral reaction is unknown, a minimum period of 15 days should be allowed to pass before repeating the injection. If this precaution is not taken, a subject still infected with the living organism may be thought to be free from glanders.

176 - The Intra-Palpebral Reaction in the Diagnosis of Epizootic Lymphangitis. — LANFRANCHI, A., in *Il Moderno Zootetro*, Series V, Year VI, No. 10, pp. 217-222, 2 figs. Bologna, Oct. 31, 1917.

The clinical diagnosis of epizootic lymphangitis, although generally fairly easy, is, however, not always possible, and under practical conditions the microscope is not always available for identifying the characteristic RIVOLTA cryptococcus. For this reason, the writer has sought a simple method for diagnosing this infection, based on the so-called "allergic" local reaction, i. e., on a special state of specific hypersensibility of the affected subjects.

(1) See R. June, 1917, No. 561 and August, No. 731. (Ed.)

The test materials are prepared in the following manner:— to 1 part of *S.* collected aseptically and known to be free from other microorganisms, parts of ether are added; shake well, then leave to stand for 24 hours; the ether is then evaporated off on the water-bath; make up to the original volume with distilled water and leave to stand for 24 hours; then heat at 50°C on the water bath for 15 to 20 minutes and allow to cool; centrifuge for 10 to 30 minutes at 2000 to 3000 revolutions per minute; decant off the supernatant fluid, which constitutes the vaccine to be used for inoculating in 2.5 cc. doses, according to the number of cryptococci in the pus used.

The injection into the eyelid is carried out in the usual way.

In healthy animals, or those infected with a disease other than epizootic lymphangitis, the injection gives rise to an oedema localised at the points of injection, or which at the most extends to the lower eyelid only. This oedema is produced in 1 or 2 hours after inoculation, attains its maximum between the 8th. and 10th. hours, then being slowly reabsorbed, and disappearing entirely after 20-24 hours. On the other hand, in animals infected with epizootic lymphangitis, the local reaction, which commences 2 to 4 hours after the injection, already extends, between the 4th. and 6th. hour, to all the lower eyelid, sensibly reducing the palpebral opening; the oedema spreads gradually and, after 24 to 48 hours, reaches the lower border of the zygomatic crest, passes it a little in front whilst progressing backwards towards the lower mandibular arch, which it may even reach. This local reaction lasts several hours, then slowly diminishes up to the 3rd., 4th. and 5th. day. The purulent conjunctivitis occurs 4 hours after inoculation and ceases in 24-48 hours.

One test for the intra-palpebral reaction has no influence on successive tests. The most intense and lasting effects of the reaction are shown by animals in which lesions have already commenced.

The use of this method of diagnosis, combined with treatment by arsenic, which was tested by FAVERO (*Moderno Zoiatro*, Scientific Part, 1917, n. p. 129), who suggested its use, would, thinks the author, cause the disappearance of the centres of infection from which the disease spreads.

**The Treatment of Epizootic Lymphangitis (1) by Means of the Autolysed Extract of Yeast.**—NICOLLE, M., FAYET and TRUCHE, in *Comptes rendus des Séances de l'Académie des Sciences*, Vol. CLXV, No. 26, pp. 1114-1115. Paris, December 31, 1917.

To fight against epizootic lymphangitis, caused by the cryptococcus discovered by RIVOLTA in 1873, an organism very close to the yeasts, the authors have tried *group antigenotherapy*. In beer yeast, they have found a cheap and efficacious therapeutic agent. Used unchanged, after the action of alcohol-ether, it remains without effect and causes abscesses, caused by the great resistance of the cell walls. Used as an autolysed extract, which the authors propose to call "*rivoltine*", it is quite successful, causing all effects. In this way is given a mixture of antigens, some of which are evidently identical with these of the cryptococcus.

(1) See R., August, 1917, No. 734, (Ed.)

To prepare the juice, pressed yeast is autolysed for 24 hours at 37°C in chloroform vapour; it is then centrifuged the supernatant liquor filtered off, phenol added; the liquid is then sealed up in small phials.

After describing the excellent results of their experiments, the authors advise the following technique:

At first inject 2 cc. (under the skin of the neck) to test the sensibility of the subject; after 4 to 8 days increase the dose to 5 cc., according to the case; after another 8 days, give 10 cc.; it may be advisable to give two subsequent injections of 10 cc.

At present, the authors are considering how to deal with possible failures and how to decrease the length of the treatment.

178 - **Leucocytotherapy; or Aseptic Pyotherapy; Its Use in Certain Cases of Equine Lymphangitis.** - BRIDÉE, J., in *Comptes rendus des Séances de l'Académie des Sciences* Vol. CLXV, No. 27, pp. 1121-1123. Paris, December 31, 1917.

Two authors, MM. BELIN and VELU, have, independently of one another, carried out successful experiments on the use of pyotherapy in the treatment of epizootic lymphangitis of the horse; pus obtained from the lymphangitic lesions is diluted in ether, then in water physiologically phenolated; the diluted pus is injected under the skin or in the jugular vein of the diseased horses, at intervals of a few days and at doses varying between 2 to 6 cc., corresponding to 0.2 to 0.6 cc. of initial pus.

These authors believe that the action of the pyotherapy is due to specific organisms contained in the pus: to the cryptococci. They consider the dilution of the pus as a "pyovaccine", and the method of treatment as "vaccinotherapy" derived from the WRIGHT method.

However, M. VELU has shown recently that the pyovaccine has not a strictly specific action and that it is efficacious in affections having no connection with epizootic lymphangitis (fistulae, various suppurations) and M. BELIN has successfully employed the method against ulcerous lymphangitis by using the pus produced by that affection; yet, in ulcerous lymphangitis, the pus often contains a very limited number of microorganisms.

These two facts attracted the author's attention and he asked whether the efficacious action of the pus was due, not to the specific organisms they contained, but rather to the leucocytes and remains of leucocytes they contained; whether, in other words, the same satisfactory results could not be obtained by injecting absolutely aseptic pus, like that of "fixation abscesses".

Experiments on this subject were carried out by treating horses suffering from ulcerous or epizootic lymphangitis with aseptic pus obtained by injecting oil of turpentine under the skin of the horse's thorax, and removing, after 4 or 5 days, pus from the abscess thus caused and mixing it with water physiologically phenolated.

The author has obtained, by injecting aseptic pus, results quite comparable with those published by MM. BELIN and VELU. He concludes that pyotherapy cannot be included under "vaccinotherapy" and that its action is due to the leucocytes of the pus and their products.

"Aseptic pyotherapy" might be employed to advantage in equine pharyngitis and in affections where pyovaccines have already proved useful. It may be that it will find a much wider application.

19 - **The Poisoning of a Horse Caused by Eating *Paspalum distichum* Parasitised by *Ustilagopsis deliquescens*.** — HUG, ENRIQUE, in the *Anales de la Sociedad rural Argentina*, Year LII, Vol. XXXI, pp. 602-603. Buenos Ayres, October, 1917.

It has been known for some years that *Paspalum* (1) is poisonous to animals; thus, MEUZE (*Handbuch der Tropenkrankheiten*, 1913) showed that the bitter variety of *P. scrobiculatum* is poisonous. In the Argentine, similar constations have been made by: RIVAS and ZANOLLI (La tembladera, *IV Congreso Científico celebrado en Santiago de Chile*, 1909); QUEVEDO a enfermedad de los rastros, *Revista zootécnica*, No. 28, 1911; Paraplegia zootóxica de los ovinos (2), *Ibid.*, No. 33, 1912; La pataleta, *Ibid.*, No. 37, 1912; Estudio de un *Aspergillus* patógeno; *Agronomía*, No. 8-9, 1912; Paraplegia enzoótica de origen digestivo, *Boletín del Ministerio de Agricultura*, Vol. XVII, No. 6, 1914; Notas sobre una nueva enfermedad de los guinos, *Gaceta rural*, 1914; etc.); QUEVEDO and LIGNIERES (Enfermedad taniforme epizootica de los bovinos, *Boletín del Ministerio de Agricultura*, 1913); MOSCONI (Paraplegia de los equinos, *Revista zootécnica*, No. 34, 1912); COSTA (El Huecú, Thesis, Buenos Ayres, 1914).

The author found that 2 kg. of dry *Paspalum distichum* strongly parasitised by *Ustilagopsis deliquescens*, when given to a horse, caused paraplegia after 2 days, paralysis and death after the 3rd. day. A post-mortem examination showed the cause was poisoning. Another horse, given 10.6 g. of *P. distichum* slightly parasitised, collected near Buenos Ayres, showed no morbid symptom whatever.

In intravenous injections in the pigeon, a 10 % decoction of the exsiccates produced on the host plant of *Ustilagopsis deliquescens* in a 5 cc. dose, and a 10 % maceration in a 2 cc. dose, proved quite harmless.

30 - **Study of *Bacterium Pullorum* Infection.** — PAIGE, J. B., in the *Twenty-ninth Annual Report of the Massachusetts Agricultural Experiment Station*, Public Document No. 31, pp. 89a-91a. Boston, 1917.

During the years 1916 and 1917 the studies on bacillary white diarrhoea in pullets have been carried out at the Massachusetts Experiment Station along the lines established. The object of the work has been to improve methods in diagnosis, to explain reasons for symptoms in certain avian diseases at present but little understood and to aid in formulating methods for prevention and control.

The work was divided in three parts:

- 1) Specificity of *B. pullorum* antibodies, with special reference to the glutinins.
- 2) Toxins elaborated by *B. pullorum* and their relation to specific conditions in adult birds.

(1) See R., 1917, Nos. 829, 924, 1179. — (2) See R. Nov. 1917, No. 1038. (Ed.)

3) Investigations concerning the production of antibodies, with special reference to potency and rate of production.

I. — The work concerning the specificity of *Bacterium pullorum* agglutinins has been continued since 1915, as have tests and procedures concerning the use of 25 strains of this organism isolated from birds in the State of Massachusetts. Recently, more than 10 new strains have been added to this list. The data obtained and that being accumulated will relate to thorough tests of the agglutinins elaborated by animals and birds against *B. pullorum*, particularly with cultures of the *B. coli*, *B. typhi*, *B. dysenteriae* group. At the present time 21 adult birds are immunized against *B. pullorum* and are producing definite agglutinins. Fourteen rabbits also are used for these studies, having been immunized and hyperimmunized during the past year.

II. — Up to the present a toxin which is suitable for carrying on progressive work has not been found. Definite studies, however, are under way toward this end. The results up to date show beyond a doubt that the toxin is endotoxic and also that it is most intimately connected with the bacterial cell. It is hoped that these studies will lead to an explanation of its action in relation to some of the paralytic conditions in adult birds which in the last few years have been so common in the State of Massachusetts.

III. — The investigation concerning the production of antibodies, with special reference to the potency and rate of production, was started in August 1916, and agglutinins artificially produced. Blood from this stock has been studied, and now attempts are being made to study the progeny this year to determine the potency of agglutinins elaborated in birds descended from stock known to have definite infection experimentally produced. These studies are to be continued, with the hope that they will show the rate of production, and demonstrate why young pullet blood testing has not given as universally satisfactory results as the blood testing of birds that have laid eggs and have ovaries capable of complete function. This problem has direct bearing on the routine work of testing breeding flocks for indications of *Bacterium pullorum* infection.

181 — Studies on the Duration of Life: Temperature Coefficients and Influencing Factors. — I. OSTERNOUT, W. J. V., Some Aspects of the Temperature Coefficients of Life Processes, in the *Journal of Biological Chemistry*, Vol. XXXII, No. 1, pp. 23-27, 1 fig., 2 tables. Baltimore, October, 1917. — II. LOEB, J. and NORTHROP, J. H., On the Influence of Food and Temperature upon the Duration of Life. *Ibid.*, pp. 103-121, 6 figs., 13 tables. — III. NORTHROP, J. H., The Effect of Prolongation of the Period of Growth on the Total Duration of Life, *Ibid.*, pp. 123-126, 1 table.

I. — In most life processes the substances formed at a given moment are broken down suddenly. If the reaction forming the substance has a different temperature coefficient from that which destroys it interesting conditions may arise. The author has made a mathematical study of the relations of these coefficients.

II. — In order to find out the nature of the causes determining the natural duration of life of metazoa, a quantitative method is required which

permit the duration of life to be represented as the numerical function of the variable. Taking as a basis the fact that, in this case, chemical reactions in the organism are one of the main variables, attempts were made to determine whether there were a definite temperature coefficient for the duration of life, and whether this coefficient were of the order of magnitude of that of a chemical reaction. The first experiments, made on fertilised and unfertilised eggs of the sea urchin, could only be carried out at the upper temperature limits of the organism, because, at ordinary temperatures, the organism lives for years. It was, therefore, necessary to use a form of life whose duration of life was short enough to measure the duration of life, even at the lowest temperatures; insects are specially fit for this purpose. MITSCHINKOFF had pointed out that bacterial poisoning may shorten the duration of life, "aseptic" (*i. e.* microorganism-free) fruit flies (*Drosophila*) were chosen.

Previous experiments made by the authors had shown that, with a regular and adequate supply of food, the duration of the larval, pupal and adult stages are each an unequivocal function of the temperature, and that the temperature coefficients for each stage are approximately identical, and of the order of magnitude of that of a chemical reaction, *i. e.* about 2.3 more for a difference of 10°C. The experiments described deal with the two main factors determining the duration of life: 1) food supply; 2) temperature. All were carried out with flies rendered "aseptic" by a combination of the methods of BOGDANOW-DELCOURT and GUYÉNOT.

1) INFLUENCE OF DIFFERENT KINDS OF FOOD. — The period of growth is limited to the larval stage. Larvae cannot grow on glucose-agar unless yeast is added, whereas the imago can live without yeast. This difference may be due to the fact that the larva requires food for the synthesis of the compounds of its body, whereas the perfect insect, which does not grow, can do without such accessory substances, or needs them in such small quantities that they can be supplied by the hydrolytic processes within its cells.

The flies from the larvae fed on yeast were placed on different culture media immediately after hatching. It was found that, at 25°C., flies fed on agar alone or on agar with the necessary salts lived less than 2 days; when dextrose and salts were added to the agar they lived over 8 days, and on glucose-agar they lived 28.5 days. At 30°C. the flies lived as long on glucose-agar alone as when yeast was added (see Table I).

TABLE I. — *Effect of food on the duration of life of the imago (both sexes).*

Food	1 gm. washed agar + 100 cc. water	1 gm. agar + 0.1 gm. KCl, 0.1 gm. MgSO <sub>4</sub> + 100 cc. H <sub>2</sub> O	1 gm. agar + 0.1 gm. KCl, 0.1 gm. MgSO <sub>4</sub> + 2.0 gm. dextrose + 100 cc. water	Glucose agar		Glucose agar + 0.005 gm. yeast per 100 cc.
				a	b	
Temperature . . . . .	25	25	25	25°	30	30°
Stage duration of life: days. . . . .	1.92	1.75	8.25	28.5	13.7	13.1

There was also found to be an influence of sex: — on glucose-agar isolated males lived longer than isolated females or than mixed groups (see Table II).

TABLE II. — *Effect of sex (30° C. and glucose-agar food).*

Sex	♂♂ ♀♀	♂♂	♀♀
Duration of life; days	13.1	15.7	13.3

2) INFLUENCE OF TEMPERATURE. — *Larval period.* — The aseptic cultures, in Erlenmeyer flasks, were kept in water-jacketed incubators regulated to  $\pm 0.10^{\circ}\text{C}$ . and containing water so that the humidity was always about 100 %. The eggs from the aseptic insects were put in the incubator and hatched very soon after they were laid. The duration of life of the larvae was reckoned from the time the eggs were placed in the incubator till the time the pupae were formed. Six to ten cultures were

TABLE III. — *Influence of temperature on the duration of larval period of Drosophila.*

Days elapsed after hatching of eggs		Number of pupae formed at						
Days counted	Average	10° (1)	15° (1)	20° (1)	25°		27.5° (2)	30° (1) + (2)
					a (2)	b (2)		
1-2	1.5	—	—	—	—	—	—	—
2-3	2.5	—	—	—	—	—	—	—
3-4	3.5	—	—	—	—	4	156	93
4-5	4.5	—	—	—	53	29	105	129
5-6	5.5	—	—	—	137	18	12	6
6-7	6.5	—	—	47	78	—	—	—
7-8	7.5	—	—	65	36	—	—	—
8-9	8.5	—	—	68	—	—	—	—
9-10	9.5	—	—	16	—	—	—	—
13-14	13.5	—	2	—	—	—	—	—
15-16	15.5	—	13	—	—	—	—	—
17-18	17.5	—	27	—	—	—	—	—
19-20	19.5	—	14	—	—	—	—	—
21-22	21.5	—	6	—	—	—	—	—
39-48	43.5	5	—	—	—	—	—	—
49-58	53.5	20	—	—	—	—	—	—
59-68	63.5	13	—	—	—	—	—	—
69-78	73.5	3	—	—	—	—	—	—
Total number of pupae		41	62	196	301	51	273	228
Average duration of larval period in days from egg to pupation)								
		57.0	17.8	7.77	5.82	4.76	4.15	4.12

(1) Flies used were of the 20th. to 22nd. aseptic generation.

(2) Flies used were of the 20th. to 31st. aseptic generation.

made for each temperature. Temperatures less than 10°C. could not be used, since the larvae do not hatch below that temperature. The results in Table III clearly show the influence of temperature.

*Pupal stage.* — A similar influence is noticed on the duration of the pupal stage, calculated from the formation of the pupa to the emergence of the winged insect.

*Imago stage.* — A similar influence.

To sum up, temperature influences the duration of all three stages, and, consequently, the total life duration of the fruit fly. (See Table IV).

III. — A third series of similar experiments showed that a prolonged period of growth prolongs the total duration of life. It has been seen that, in the case of the "aseptic" *Drosophila*, growth may be greatly retarded by absence of yeast. The prolongation of the larval stage affects neither the duration of the pupal stage nor (as is shown by these last experiments) that of the imago stage. This proves the relative duration of each of the three stages to be independent of that of the other two stages; it coincides with the hypothesis that the duration of each of these stages is determined by the formation or disappearance of a definite specific substance.

TABLE IV. — *Influence of temperature on the total duration of life (Drosophila).*

Temperature	Duration, in days, of			Total duration life from egg to death
	Larval stage	Pupal stage	Imago stage	
10°	57.0	Pupae die	120.5	177.5 ± X
15°	17.8	13.7	92.4	123.9
20°	7.77	6.34	40.2	54.3
23°	5.82	4.23	28.5	38.5
27.5°	(4.15)	3.20	—	—
30°	4.12	3.43	13.6	21.15

h - **Physiological Effect on Growth and Reproduction of Rations Balanced from Restricted Sources.** — HART, E. B., Mc COLLUM, E. V., STEENBOCK, H. and HUMPHREY, G. C., in the *Journal of Agricultural Research*, Vol. X, No. 4, pp. 175-198 + Plates 18-32, Washington, D. C., July 23, 1917.

This paper summarises the results of further studies on the physiological value of restricted rations. The early work of the writers (1) demonstrated clearly the inadequacy of the accepted theory as to what constitutes a balanced or complete ration. Up to that time total protein (without reference to quality), energy, and ash materials were considered the essentials of a ration. The latter, however, occupied no position in the expression of the standards developed which have been stated only in terms of total digestible protein and energy. It is, however, probably

(1) Mc COLLUM, E. V., STEENBOCK, H. and HUMPHREY, G. C., *Idem*, in *Wisc. Agr. Exp. Res. Bul.* 17, pp. 131-205, 24 fig. Madison, Wisc., 1911.



true that, in a practical sense and with the generally accepted knowledge of the quality of feeding materials accumulated from a long and varied experience, such standards have had and will continue to have very great value; but their limitations are also made evident by this earlier work of the writers and are emphasised by what they have since done.

To day a ration can be considered complete and efficient only when it contains protein of adequate quantity and quality, adequate energy, adequate materials in proper quantity and proportion, and two factors of unknown constitution (vitamines) which the writers have designated as "fat-soluble A" and "water-soluble B". In addition to these normal factors, there may be introduced with natural foodstuffs the important factor of toxicity. This can be wholly absent or so mild in its effects as to be entirely observed when the other essentials of a ration are at an optimum adjustment.

#### EXPERIMENTAL WORK STARTED IN 1910 ON WHEAT AND CORN RATIONS

— In order to locate the deficiencies of the all-wheat-plant ration (wheat grain, wheat gluten, and wheat straw), which had given fair growth, there was a failure in reproduction with grade Shorthorn heifers, a new series of experiments was again started in 1910, using for the purpose vigorous Holstein heifers of initial weights of from 200 to 400 pounds. It was proposed that one group should receive its nutrients wholly from the wheat plant, another from the wheat plant, a third from corn grain and wheat straw, a fourth from wheat grain and corn stover, while a fifth group should receive its nutrients from corn grain with the roughage equally divided between alfalfa hay and wheat straw. These rations were closely comparable in digestible proteins and net available energy and were balanced in the ordinary sense of the standards. The animals were fed what they would consume of this mixture and, in addition, received common salt and natural water. They were allowed a daily run to an outside paddock free from vegetation. Their records of growth and final status are given in Table I.

Restriction to the wheat plant as a source of "balanced" nutrition did not sustain the growth of the heifers. Such animals also failed to become oestrus and could not be bred. Marked pathological conditions resulted such as blindness, feeble and emaciated condition, and abnormal excitability followed by collapse. The critical factors in this ration were poor nutrient content and toxicity. This statement is based on records made by the animals of this species and on records with rats and swine.

In contrast to the all-wheat-ration group stood the all-corn-ration group. The latter not only showed continuous growth, but became physiologically active and produced strong calves. The decline in weight at the end of two years shown by No. 575 was due to slow recovery after calving.

By the use of corn stover as a roughage in place of the wheat straw growth was sustained but reproduction was only partially successful, dependent upon the stamina of the mother. Where reproduction was successful in the first gestation period, it failed in the second, owing to the cumulative effect of the wheat toxicity.

By the use of alfalfa hay to take the place of one-half of the wheat

aw, results similar to those with corn stover were secured. Growth was ended, reproduction normal in the first gestation period, but weakness period in the second gestation.

TABLE I — *Record of Growth of Holstein calves 1910-1912.*

No. of Animal Ration	Weights in pounds.					Condition after 2 years
	Initial (June 2, 1910)	After 6 months on ration	After 1 year on ration	After 18 months on ration	After 2 years on ration	
Corn and wheat, 8 pounds	377	655	569	611	482	Miserably emaciated.
Wheat gluten, 0.3 pounds						Do.
Wheat straw, 5.7 pounds						Do.
Wheat grain, 0.7 pounds	406	722	683	630	810	Do.
Wheat gluten, 0.3 pounds						Do.
Corn stover, 7 pounds	306	309	333	626	700	Fairly strong.
Corn meal, 5 pounds	307	377	594	783	826	Do.
Chicken feed, 2 pounds	343	664	609	1130	974	Strong and vigorous.
Corn stover, 7 pounds	270	196	238	235	625	Do.
Corn meal, 5 pounds						Do.
Chicken feed, 2 pounds	208	301	470	541	660	Very strong and good condition.
Wheat straw, 1 pound	220	364	541	681	740	Do.
Corn meal, 5 pounds						Do.
Chicken feed, 2 pounds		613	686	641	1161	Strong and vigorous.
Wheat straw, 3.8 pounds						Do.
Alfalfa hay, 3.5 pounds		337	502	800	772	Do.

The alfalfa and corn stover introduced a better salt mixture, a little different protein mixture, and probably a more plentiful supply of growth-nutrient substances, all of which, according to the writers' hypothesis, did either individually or collectively improve the ration but not necessarily make it perfect. It might still fail if the mass of toxicity was too great.

Baking the wheat grain did not improve it. The particular effect of all-wheat-grain rations was to cause marked histological changes in nervous tissues of the offspring. The motor cells partly degenerated and spinal cord showed a more or less oedematous condition. This was in line with the writers' observations on swine with wheat-grain feeding. Wheat-grain and wheat-straw rations growing heifers also showed symptoms of nerve degeneration, as evidenced by blindness and great excitability. The cause of the disturbance was due to the inherent toxicity of the wheat grain and not to "deficiencies of vitamins".

Corn grain plus wheat straw allowed sustained growth, but at a slow rate. The offspring were weak or dead. Addition of salt to this ration made it normal, indicating that this was the only factor needed for perfect nutrition with this ration.

A physiologically complete ration such as the corn-grain and corn-stover mixture could not be disturbed, at least in a single gestation, by

altering the calcium-magnesium ratio through the addition of magnesium salts. Even the addition of mineral acids to this ration, in such quantities as to make the urine of the individuals receiving it acid to litmus and rich in ammonium salts, did not disturb its nutritive completeness.

The addition, however, of wheat embryo to a corn ration did cause disturbances, bringing about early abortions. This was due to its high content of the toxic material of the wheat kernel.

Considering the influence of these investigations on practice, the writer points out that there is already much trouble with reproduction by cows in the Dakotas, wherever much wheat straw is fed with corn grain. In many cases where the breeding stock was only fed wheat grain and certain roughages, the calves were born either dead or weak, with great financial losses to many breeders. No one would have suspected that the ration was a factor in these disasters, but it undoubtedly was the direct cause of the trouble.

The data presented include also the study of the influence of the factors on milk secretion.

183 - On the So-Called Specificity of the Abderhalden Reaction. — BOLDYREFF, W., in *Comptes Rendus des Séances de la Société de Biologie*, Vol. LXXX, No. 18, pp. 882-884, Paris, November 24, 1911.

The ABDERHALDEN reaction is based on the fact, as yet unproved, that the ingestion of albuminoid substances causes the appearance of specific proteolytic ferments in the blood.

For 16 years, the author, in collaboration with M. J. KNIAZEFF, has been carrying out researches on the work of digestion, as distinct from digestion. These researches, which have been carried out on 10 persons, hundreds of dogs, cats and birds, throw new light on the ABDERHALDEN reaction.

Contrary to general belief, the stomach and the intestine with its glands do not remain inactive after digestion; on the contrary, these organs carry out a well defined and intense work which is regularly interrupted by periods of complete repose. This activity of the stomach and of the intestine with its glands, which takes place during fasting, has been called "periodic work of the digestive apparatus apart from digestion." This is what takes place: the animal being fasting, and the gastric glands quite inactive, from time to time, with the regularity of clockwork, the pancreatic and intestinal glands as well as the gall-bladder, produce a secretion; this secretion is accompanied by intense rhythmic contractions of the stomach and small intestine.

This simultaneous "work" of the organs in question lasts from 20 to 30 minutes in the dog, and a little longer in man; the consecutive phase of "rest", which affects all the organs in question at the same time, lasts about an hour in the dog, and a little less in man.

During each period, 25 to 30 cc. of a mixture of digestive juices can be withdrawn from the duodenum of the dog, and 50 to 60 cc. from that of man. These juices contain abundant intestinal ferments that act on albumin.

oids, fats and carbohydrates; they are afterwards absorbed without change in the small intestine and never reach the large intestine.

Experiments by M. KNIAZEFF and the author have shown that these ferments, one of which is a proteolytic ferment, penetrate, during the period of "work", into the blood, where they can be easily demonstrated. During "rest" periods the ferments in question disappear from the blood. These appearances and disappearances take place with the greatest regularity, a fact that forms the first cause of error in the ABDERHALDEN reaction.

The second error is as follows: If the blood of a man or woman is examined during the period of work of the digestive apparatus, it is found that the ABDERHALDEN reaction gives a positive result with any albuminoid substance (placenta, lungs, fibrin, etc.) On the other hand, if blood be examined that has been obtained during the rest period from the same subject the same day, the ABDERHALDEN reaction always gives a negative result, even with gravid females.

As this reaction is not specific, the author concludes, it has no diagnostic value, but it is very useful for showing the presence of proteolytic ferments in the blood.

**Influence of Date of Cutting on the Food Value of Hay; Experiments carried out in Denmark.** — KAISTEN, IVERSEN and KRISTENSEN, R. R., in *Tidskrift for Planteavl.*, Vol. XXIV, Pt. 3, pp. 405-435. Copenhagen, 1917.

The experiments described were carried out at the agricultural School Taaesgaards in order to determine to what extent the date of cutting influences the composition and yield in hay of clover, either alone or mixed with other grasses. The dates of the first cutting were: June 16, when the clover began to flower; June 26, when the clover was in full flower and the grasses began to flower; July 9, when the clover had already partly lost its flowers.

**QUANTITY OF FODDER.** — The date of the first cutting seems to have little influence on the total yield of the three cuttings; the third cutting diminishes in quantity with the later date of the first cutting.

TABLE I. — Relation of quantity of hay to the date of the first cutting.

1st. cutting		2nd. cutting		3rd. cutting		Total
Date	Cwt.	Date	Cwt.	Date	Cwt.	Cwt.
June 16.	52.70	August 9.	24.98	October 15.	8.10	86.00
June 26.	52.62	August 15.	28.32	October 15.	6.98	87.98
July 9.	55.24	September 11.	30.88	October 15.	1.72	87.90

**CHEMICAL COMPOSITION.** — This is shown in Table II; the moisture content is 15% for all samples.

TABLE II. — *Composition of hay cut at different dates.*

	Early cutting	Late cutting
Albuminoids . . . . .	10.2	8.5
Fat . . . . .	2.6	2.5
Fibre . . . . .	20.0	22.1
Nitrogen-free extract . . . . .	30.6	31.0
Pentosans . . . . .	13.3	14.0
Ash . . . . .	8.2	6.5
Moisture . . . . .	15.0	15.0

Hay cut early is distinguished by its high albuminoid content and by its ash percentage, whereas it is relatively poor in fibre and pentosans.

EXPERIMENTS WITH DAIRY COWS. — The date of cutting does not influence the composition of milk, but influences its production to a marked degree; with 200 lbs. of hay cut early 16.28 lbs. more milk were obtained than with an equal quantity of hay cut late.

EXPERIMENTS ON THE GROWTH OF CALVES. — The experimental animals were divided into three groups. Care was taken to choose calves of equal age and weight so that an increase in weight could be with certainty attributed to the hay. The most important results are summarised in Table III.

TABLE III. — *Experiments with calves fed on hay cut at different dates.*

		Increase in weight each 10 days		
		Early cutting	Normal cutting	Late cutting
		lbs.	lbs.	lbs.
Year 1913.	1st. period.	12.28	11.44	9.78
	2nd. period.	11.06	10.56	9.92
Year 1914.	1st. period.	10.56	9.40	7.62
	2nd. period.	13.42	10.78	8.80
Year 1915.		8.68	—	6.37
Averages of 4 experiments 1913, 1914.		12.10	10.56	9.24
Averages of 5 experiments 1913, 1914, 1915.		11.44	—	8.90

During a period of 100 days the following increases in weight were obtained: — hay cut early, 121.00 lbs.; normal hay, 107.80 lbs.; hay cut late, 92.40 lbs. The early hay, therefore, gives the best results.

DIGESTIBILITY. — These experiments were carried out with two animals fed exclusively on hay cut early and hay cut late.

The greater digestibility of early-cut hay and its greater number of calories explain the higher production of milk and more rapid growth of the calves.

TABLE IV. -- Digestibility of hay according to the date of cutting.

	A) Early cutting	B) Late cutting	Difference A-B
	%	%	%
g matter . . . . .	60.8	53.7	7.1
protein . . . . .	72.6	60.9	11.7
nitrogen . . . . .	60.6	54.4	6.2
cellulose . . . . .	53.2	46.3	6.9
lignin . . . . .	42.4	34.8	7.6

5 - The Feeding Value of the *Eragrostis* of the Argentine. — See No. 165 of this Review.

5 - The Insufficiency of Maize as a Source of Protein and Ash for Growing Animals. — HOGAN, ALBERT G. (Department of Chemistry, Kansas State Agricultural Experiment Station, Manhattan, U. S. A.), in the *Journal of Biological Chemistry*, Vol. XXIX, No. 3, pp. 485-493, 3 diagr. Baltimore, April, 1917.

Agriculturalists have known for a long time that maize kernel does not suffice as a diet for growing animals. Experiments on young rats have shown the first limiting factor for growth to be a lack of certain inorganic constituents. When the mineral deficiencies were corrected normal growth was not obtained, even after the addition of considerable quantities of refined protein, thus proving a lack of suitable growth accessories. According to Mc COLLUM, and his collaborators, maize kernel is lacking in an accessory, called by them "fat-soluble A". (1). The author's previous experiments show that mineral deficiencies in maize are tolerated much better by swine, and protein deficiencies are tolerated better by rats. Assuming that maize is poor in one or more of the growth accessories, swine are much less affected by it than are rats.

The author has continued his earlier work in order to determine specially what inorganic elements in the ash, and what amino-acids in the proteins are deficient in quantity, thus constituting limiting factors. It was shown that the addition of tryptophane and lysin improved the proteins of maize, and later, that tryptophane is the first limiting factor in the proteins of the maize kernel, and that lysine is the second. The most important mineral deficiency of maize is calcium.

7 - The Effects of Feeding Calcium Chloride to Domestic Animals (2). — LOEW, O., in *Mitteilungen der Deutschen Landwirtschafts-Gesellschaft*, Year XXXIII, No. 37, pp. 501-504, Tables 3. Berlin, September, 1917.

The rational use of calcium chloride in feeding domestic animals gives good results, both in increasing the general production as in improving an unhealthy condition. These results are very useful, especially when the relatively small amount of chloride required and its low price are considered.

(1) See R. Jan., 1918, No. 2. — (2) See R. 1915, No. 106 (Fed.).

The writer analyses the effects produced, and collates the results obtained by various workers for horses, cattle and pigs.

**HORSES.** — An experiment was made by THUNN on 7 full-grown horses affected with gastric and cardiac troubles. Their daily ration was made up of 1 kg. of oats, 750 gm. of whole maize, 1250 gm. of raw sugar and 7 kg. of hay, plus a daily dose of 30 gm. of crystalline calcium chloride dissolved in 250 gm. of water. The experiment lasted from March 6 to May 29, 1911. During these eight weeks the animals showed a noteworthy increase in live weight (see Table I), as well as an improved state of health. Calcium chloride cures animals of bad habits such as crib-biting, licking the walls, eating sand, etc. — habits that appear to show the lack of some necessary element in the food and also prevents other troubles, such as exostoses, so common in young horses. The results are all the more evident, the lower the calcium content of the food. It is thus desirable to take account of the abundance or lack of lime in the food given; the minimum content is 10 gm. of lime per kg. of hay. Very often this amount is not reached; in addition, pasture on soil poor in lime, manured only with kainit, superphosphates or basic slag can only produce a defective food, often producing deformed front legs, exostoses, etc. (WEGOLD).

TABLE I. — *The effect of calcium chloride on the growth of horses.*

Names of the horses	Weights found during the experiment							Increase in weight at end of the experiment
	March 6th.	March 20th.	April 3rd.	April 17th.	March 1st.	May 13th.	May 29th.	
Patron . . . . .	475 kg	482 kg	484 kg	495 kg	495 kg	497 kg	—	22 kg
Luzia . . . . .	—	162	473.5	480.5	494.5	496.5	—	30.5
Schleier . . . . .	—	354	370	377	372	360	364 kg	10
Salome . . . . .	—	407	407	416	424	479	—	17
Nussbäher . . . . .	—	400	401	402	403	412	414	14
Rektor . . . . .	—	—	383	376	389	394	413	23
Nichte . . . . .	—	—	367	369.5	381.5	393.5	—	26

**CATTLE.** — Calcium chloride also produces good effects on the general growth and milk production. A group of 10 cows and 2 sick young animals were experimented with for 28 days by HÖHKE. The daily dose was from 0.02 to 0.04 gm. per kg. live weight for the cows and from 0.01 to 0.02 gm. per kg. for the young animals. The full-grown animals, of which 2 were sick, were about 5 years old. The weights of the animals and the daily yield of milk are given below in Tables II and III.

The increased yield in milk of 5 of the experimental animals is characteristic and, in certain cases, an increase in yield of 1.1 litres per day has been observed; on discontinuing the use of calcium chloride, the yield immediately falls. The young animals showed the benefit of giving calcium chloride; they grew better, their rough hair became smooth and lustrous and they became fatter.

TABLE II. — *Effect of calcium chloride on the live weights of the cattle experimented with.*

	Live weight		Increase (+) or decrease (—) of live weight
	Before using calcium chloride	After using calcium chloride	
pw No. 1 . . . .	500 kg	544 kg	+ 44 kg
" 2 . . . .	460	467	+ 7
" 3 . . . .	440	462	+ 22
" 4 . . . .	440	460	+ 20
" 5 . . . .	480	517	+ 37
" 6 . . . .	510	484	— 26 (sick)
" 7 . . . .	450	473	+ 23
" 8 . . . .	570	580	+ 10
" 9 . . . .	430	405	— 25 (sick)
" 10 . . . .	400	434	+ 34
y. young animal . .	100	107	+ 7
ad. " . . . .	90	97	+ 7

TABLE III. — *Effect of calcium chloride on milk production.*

	Average milk produced in litres		
	Before use 1st period (7 days)	During use 2nd period (25 days)	After use 3rd period (21 days)
pw No. 1 . . . .	7.535	8.250	7.135
" 2 . . . .	9.820	9.660	8.990
" 3 . . . .	8.175	8.295	5.595
" 4 . . . .	5.070	5.555	4.455
" 5 . . . .	5.570	6.125	4.455
" 6 . . . .	13.140	12.920	9.155 (sick)
" 7 . . . .	8.070	8.270	7.015
" 8 . . . .	3.460	2.180	—
" 9 . . . .	7.785	7.095	5.610 (sick)
" 10 . . . .	6.070	5.700	6.100

FIGS. — Two sows were experimented on by STADELMANN; one, used as a control, weighed 126 kg.; the other, weighing 195 kg., was given 14 gm. of crystalline  $\text{Ca Cl}_2$  every day; the second animal put on 9 kg. in 22 days, while the first only increased in weight by 5 kg. It should be noticed that 14 gm. is too heavy a dose; a suitable dose would be 4 gm. per 60 kg. live-weight; better results are then obtained. Speaking broadly, the nature of the food given should be considered, on the one hand, as well as the fact that a young animal eats much more in *proportion to its weight* than a full-grown animal.

CONCLUSION. — Calcium chloride can be very usefully fed to live-stock when the food is lacking in calcareous matter; moreover, when the food only contains this matter in slightly assimilable form, the chloride is then the most suitable salt to give.



188 - Increased Cattle Production on South-Western Ranges of the United States -

JARDINE, J. T. and HURTH, L. C., in *U. S. Department of Agriculture, Bulletin No. 58*, pp. 1-32. Washington, D. C., November 15, 1917.

This bulletin presents the results of experiments made by the Forest Service on the Jornada Range Reserve, a unit comprising 200 000 acres in New Mexico, with the purpose of working out a system of range management and improvement, practicable for large grazing units, which will build up the depleted areas and ensure the maintenance of the whole range in good condition.

The problem involves : — a) Finding a system of management that will best bring about natural reseeding of the existing forage plants, b) finding new plants suitable for seeding on the ranges of the Southwest ; c) determining the number and distribution of stock-watering places necessary for efficient use of the range, taking into account cost of construction and returns expected ; and d) determining the carrying capacity of the range as a means of preventing its being overstocked. Other and related range problems also have been studied on the Jornada Reserve. One of these has to do with improving the average grade of stock and the average calf crop under range conditions, the possibility of which is generally recognized. Another is how to reduce the losses of stock from lack of feed and water in times of drought and from disease and straying that ordinarily occur in the Southwest.

These studies on the Jornada Reserve are by no means completed; the results so far secured, however, seemed to have an important enough bearing on the problem of increased meat production, to justify the publication of this progress report which illustrates methods already successfully applied on a practical scale since 1912 when the Reserve was created by Executive order.

The Jornada Range Reserve is located in Dona Ana County N. Mex. in the Rio Grande Valley, about 50 miles north of the Mexican boundary. It is typical of a large territory in the Southwest which, owing to natural and climatic conditions, will probably always be best adapted to the production of live stock on comparatively large holdings.

The eastern portion of the Reserve includes the west slope of the San Andreas Mountains which reach a maximum elevation of about 7 600 feet, and the remainder of the Reserve is a comparatively flat or slightly rolling plain.

The locality is one of the most arid of the Southwest. Records for 55 years at Mesilla Park, about 15 miles southwest of the Reserve, show an average annual precipitation of 8.63 inches, with precipitation for individual years as much as 17 and as little as 3.50 inches. Temperatures as high as 106° F. are common in summer, and the region is subject to almost continuous high winds and, consequently, high evaporation. The soils of the plain are rather coarse to medium textured wind-blown sands, with patches of heavy adobe clay, usually with a rather high percentage of alkali, where water often stands until evaporated. The soils of the mountains and the outwash plains flanking them are coarse sands and gravels.

The vegetation is comparatively thin and made up of drought-resistant

mid-desert species. By far the greater part of the forage, perhaps 80 %, is furnished by perennial grasses, of which the most important are grama grasses.

Black grama (*Bouteloua eriopoda*) is the most important grass of the reserve. Blue grama grass (*B. gracilis*) and hairy grama grass (*B. hirsuta*) are found only in the mountains and foothills.

Next to the grama grasses in importance are three-awn grasses known locally as "needle grasses" (*Aristida longiseta*, *A. pansa*, and *A. purpurea*); Joshua grass (*Hilaria mutica*).

The drop-seed grasses include several species, the most important being *Parobolus cryptandrus*, *S. flexuosus*, *S. wrightii*, *S. airoides*, *S. auriculatus*.

The most important species of muhlenbergias are *Muhlenbergia gracillima* and *M. porteri*.

Burro grass (*Scleropogon brevifolius*) and wolftail (*Lycurus phleoides*) are also to be found.

On large areas of the foothills, black brush (*Flourensia ceruma*), creosote bush (*Covillea glutinosa* = *Larrea glutinosa*) and mesquite (*Prosopis glandulosa*) predominate; but black brush and creosote bush are worthless as forage, and the mesquite is of low value.

Stock water for the plains, both on the Reserve and on the adjacent range lands, is pumped from deep wells by windmills and engines or is provided by tanks which catch the flood waters. As a usual thing, there is not enough water for the stock.

EXPERIMENTAL RESULTS SO FAR OBTAINED IN RANGE MANAGEMENT. — *Range Improvement by Natural Revegetation.* Primarily as a result of 1) reducing the number of stock during the main growing season of about six months — July to October — to about half the average number the area will carry for the year, 2) not overstocking during the other eight months, and 3) better distribution of stock watering places, grama grass range on the Jornada Range Reserve has improved in three years at least 50 per cent. as compared with similar adjoining unfenced range grazed all the year. Observations to date indicate that range thus lightly grazed during the main growing season has improved approximately to the same extent as similar range protected from grazing the entire year.

On fenced grama-grass ranges of the Southwest where the stock are carried mainly on range feed throughout the year, light stocking during the growing season is profitable.

It will probably not reduce the total animal-days' feed furnished on a given area during the year, and will reserve feed for the critical period from February to July, or later in case of prolonged drought.

Where the whole of a range unit is made up of grama or similar grass, but one third of the area should probably be reserved for light grazing during the growing season two years in succession. Each third in turn should be given as nearly as practicable this amount of protection. By light grazing is meant grazing by not more than half the average number of stock that the area will carry for the year as a whole.

*Water Development* — Fairly efficient use of plains and mesa range in the Southwest can be secured where stock do not have to travel more than

2  $\frac{1}{2}$  miles to water. This means one watering place for each 13 200 acres. Such an acreage of grama-grass range will carry about 500 cattle throughout the year if properly managed. When feed is short, a long distance between feed and water tends to increase the loss of stock, to decrease the calf crop, and to retard development of the young animals.

Observations to date appear to justify one permanent watering place for each 500 head of cattle. Where conditions are favorable the construction of tanks to catch flood waters for the purpose of supplementing the permanent watering places will be a paying investment.

They will aid: 1) in getting more green feed for the stock during the year; 2) in more even utilization of the range as a whole; 3) in the protection of feed and range near permanent water; and 4) in reducing the cost of maintenance and operation of wells.

*Carrying Capacity.* — During 1916 the Jornada Reserve as a whole supported one animal, not including unweaned calves, on an average of 41.45 acres. The estimated maximum carrying capacity of the Reserve in its present stage of development is 38.1 acres per head. The estimated carrying capacity of similar unfenced range in its present average condition is at least 50 acres per head.

The range of the plains, where grama grasses form the bulk of the forage, will support stock throughout the year at the average rate of one head to from 20 to 30 acres, depending upon the proportion of the real grama-grass type. This figure is for range in good condition, fairly well supplied with stock water, and which is lightly stocked during the growing season.

The range comprising tobosa-grass flats, along drainage lines, and slopes back to the foothills will support stock throughout the year at the average rate of one head to from 38 to 45 acres, depending upon the percentage of tobosa flats which receive flood water.

The mountain range of the Jornada Range Reserve will support stock at the rate of approximately 60 acres per head in its present stage of development.

*Increase in Calf Crop and Improvement in Grade of Stock.* — From 500 selected cows and 20 bulls, held in pastures away from other stock since August 1915, an 81 per cent. calf crop was branded in 1916.

From the remaining cows of breeding age, amounting to 1 522 head run together in one pasture of 74 714 acres, a 69.2 per cent calf crop was branded. The average calf crop for the Reserve was 72 per cent. A total of approximately 50 pounds of cottonseed cake per head was fed to the 500 cows and 20 bulls of the selected breeding herd on the Reserve.

The work of caring for this herd took half of one man's time. The extra calves in this special herd far more than paid for the extra feed and labour.

*Prevention of Loss.* — The average loss of stock on the Jornada Reserve from June 1 to December 31, 1915, was at the rate of 1.9 per cent. for a year, the average loss in 1916 was 1.5 per cent. The average losses for New Mexico are approximately 10.6 per cent for calves to 12 months of age, 5.6 per cent for yearlings, and 5.8 per cent for other stock.

The small loss at the Jornada Reserve is attributed to careful systematic vaccination against blackleg, to the reservation of grama grass range for

poor stock during the critical spring months, to feeding the animals a small quantity of cottonseed cake and to prevention of straying.

In order to provide for extra range for the breeding stock in poor years, one third of the stock on a range unit should be steers. It is then possible to reduce or increase the stock according to years without interfering with the breeding stock.

To provide against loss in extremely bad years some kind of roughage to supplement the range forage, for feeding with cottonseed cake or other concentrated feed, would be a decided advantage on southwestern ranges.

Ensilage made from soap weed (*Yucca elata*) has been tried, and the results are promising but not extensive enough to warrant definite conclusions.

Range feed not more than 2  $\frac{1}{2}$  miles from water is a big factor in cutting down loss from starvation, especially where little or no supplemental feeding is done.

89. **The Awankari Cattle Herd of the Peshawar Agricultural Station in the North-West Frontier Province of India.** — BROWN, W. ROBERTSON, in *The Agricultural Journal of India*, Vol. XII, Part IV, pp. 588-592. Calcutta, October, 1917.

In the autumn of 1916 ten beautiful typical Awankari cows were introduced, from their home in the North Punjab, to the Peshawar Agricultural Station. Awankari cattle, although alien to the North-West Frontier Province, are valued above other breeds by the cultivators, because they are hardy, handy, powerful and fast alike in the cart and in the plough, and handsome in appearance. Their even black and white markings and free bold carriage appeal to breeders; but until these cows arrived at the Agricultural Station there was not a pure-bred female of the breed in the Peshawar District.

*Awankari Herd at the Peshawar Agricultural Station.*

*Cows.*

Name	Age	Years	Length	Height	Girth	Shin	Colour	Price	Calfborn	Remarks
Inches								Rs.		
Hirna	4	48	45 $\frac{1}{2}$	63	6		Black and white	85	9-7-17	A big cow
Adrai	7	49	47	61	6		"	80	8-3-17	Rather coarse
Kargiana	4	44	44	59	5 $\frac{3}{4}$		"	74	14-2-17	A fair milker
Arina	6	51	47	60	6		"	90	20-8-16	Beautiful cow
Kussolai	5	50	47	61	5 $\frac{3}{4}$		"	92	4-5-17	Typical animal
Kesame	1	50	49	62	6		"	100	12-2-17	Poor milker
Kahbuba	4	52	47	64	6		"	100	19-3-17	Good milker
Kazbina	3	50	47	60	5 $\frac{3}{4}$		"	85	25-12-17	Fair milker
Gilla	7	52	41 $\frac{3}{4}$	59	6		"	85	1-5-17	Good milker
Kanai	8	48	47	62	6		"	65	—	Typical cow
							<i>Bull.</i>			
Kustum	4	60	51	75	7		"	130		Handsome typical bull
							(2 years)			
							<i>Bullocks.</i>			
	6	54	52	68	7		"	140		A beautiful
	6	57	52	6	6 $\frac{1}{2}$		"	140		well-matched pair

Four of the cows are by no means poor milkers, so it is hoped that a herd of fair milkers may ultimately be established without sacrificing any of the more important qualities the breed now possesses. The young stock promise to be excellent typical specimens fit for stud, or inclusion in the Station Herd Book. In the table of measurements given below, the cows compare unfavourably with the bull and bullocks in size and "bone" because the calves were originally generously treated, whilst the females received bare sustenance.

A set of 5 photographs is given in the original text.

190 - **The New Zealand Sheep Returns in 1917 and the Progress of Crossbreeding in New South Wales.** — *The Pastoral Review*, Vol. XXVII, No. 11, pp. 1040-1041. Melbourne, November 16, 1917.

The complete figures of the New Zealand sheep returns just issued, show that there has been an increase of 482 236 over the previous year. The increase for the North Island is 686 329 and the decrease for the South Island 204 093. The New Zealand figures supply much interesting and valuable information because separate totals are given of stud rams, flock rams, wethers, breeding ewes, dry ewes and lambs.

According to these returns there were in the Dominion 10 484 stud rams, 318 766 flock rams, 3 457 000 wethers, 13 260 000 breeding ewes, 1 072 647 dry ewes, and 7 150 516 lambs. There is also shown the number of stud sheep entered in the flock book, and the sheep of a distinctive breed but not entered in the flock book. Romneys, Lincolns, Border Leicester and Southdowns, the favourite crossing breeds, lead the way, but the first-named is far ahead of the rest, there being 117 478 stud and 3 702 641 flock Romneys, as against 40 083 stud and 585 943 flock Lincolns, which come second. Border Leicester studs and flocks number respectively 35 462 and 311 497, Southdowns 26 393 and 50 019, English Leicesters 24 367 and 173 146, Merinos 17 187 and 1 063 491, and Shropshires 4 109 and 22 350. The number of crossbreds and others not otherwise enumerated is 18 395 222.

The figures for New South Wales also throw an interesting light upon the development of crossbreeding. In the 1907-1908 season the percentage of crossbred wool sold in the Sydney market was 3.77 % of the total offerings. It steadily increased to 8.73 % in 1912-1913, and the following year suddenly increased to 11.05 %. From then onwards progress was more rapid and during the 1916-1917 season the wool sold in Sydney was 21.14 % crossbred and 78.86 Merino. Unfortunately, there are no accurate statistics available illustrating this development in the various pastoral districts of each State. It would be interesting to know whether this increase of crossbred wool is the result of an increasing use of sheep on the wheat area or whether the crossbred is making a steady encroachment on to what has hitherto been considered pure Merino country. It would also be most useful to know what Longwool breeds are forming the basis of such marked development in crossbreeding. It is well known that the Romney, Lincoln and Leicester are the predominating British breeds in New South Wales and New Zealand, that are used for crossing with the Merino, but there are no statistics for the Australian States which can be taken as evidence of

a relative part each breed is playing in this increasing production of shorn wool.

The 25 270 386 sheep of New Zealand belong to 23 380 different owners, giving an average of a little over 1000 sheep per owner. There are no less than 18 255 owners whose flocks do not exceed 5000 and 11 809 of these owner's flocks do not exceed 500. There are only 38 owners with flocks exceeding 20 000. The number of owners has increased during the year by 9. This increase is partly due to new settlers starting flocks, and to a smaller extent to dairy farmers who have been forced, by shortage of labour, to give up cows for sheep.

1 - **The Importance of Hogs for the Meat and Hides Supply.**—TISH, P. A., in the *Journal of the American Veterinary Medical Association*, Vol. LII, No. 3, pp. 215-217. Ithaca, N. Y., December, 1917.

It is estimated that at present there are in the United States 4 000 000 hogs less than there were a year ago. Outside of the United States there has been a decrease of 39 525 000 hogs. This number has been exceeded only by sheep. Cattle are not far behind the hogs in their diminishing numbers.

To assist in meeting the great demand for meat the U. S. Department of Agriculture estimates that the number of hogs should be increased 15 per cent. for the entire country. In some states the increase needed is only 5 per cent., in others, as much as 50 per cent. This policy seems completely justified because among the domesticated animals there are none so prolific; none which produce so great a return in so short a time; none in which a wide variation in diet is possible; none more useful in the variety of products afforded.

Nevertheless, there is one important product of the hog which does not seem to be used at its best advantage, under modern methods of curing ham and bacon, and that is the hide.

The deficiency in leather is becoming serious and pig skin is the only substitute, in large quantities, available for cowhides. The skins of the millions of hogs slaughtered annually could be converted into the finest kind of leather. Such leather is superior to cow hide in resisting surface wear and has been used for years, but in limited quantities, in making the best saddles and fancy leather goods. It has been tested and found thoroughly practicable and satisfactory for shoes.

It is stated there is a shortage of three million cowhides to meet in the leather market. The pigskins would make up this deficiency twice over considering that the presence of the skin is not indispensable in preserving the meat, under the modern methods of curing.

In the supply of meat and leather, the hogs, as quick breeding animals, are therefore to meet the need. Unfortunately they are susceptible to diseases which annually take a toll of millions from the supply. But the use of anti-hog cholera serum is to day far beyond the experimental stage, has checked the disease in the infected herds and immunized healthy hogs exposed to the disease; therefore, with a greater educational interest

and with proper cooperation on the part of the producers and of the veterinarians, it seems only a question of time and organization to avert the menace of hog cholera.

- 192 - "Le Sughere" Hive with Cork Frames. — PECCHINI, GIOVANNI, in *L'Apicoltura Italiana*, Year XIII, No. 12, pp. 188-189. Ancona, December, 1917.

In order to protect the bees against heat, cold and especially sudden changes of temperature in spring, the author constructed a hive with cork frames. All models may be built on this system.

- 193 - The Cotton Plant as a Honey-Yielding Plant. — CHACARAS e QUINAES, Vol. XVI, No. 2, p. 299. São Paulo, October 15, 1917.

It is not generally known that the cotton plant is one of the best honey yielding plants. The honey obtained from it is very clear and, when it is completely ripe, very sweet. It granulates easily and, when solid, of a very fine, almost white grain.

- 194 - Comparative Research on the Value of the Electrical and Chemical Treatment of Silkworm Eggs (1). — ACQUA, C., in *Informazioni Seriche*, Year IV, No. 21, pp. 491-494. Rome, Nov. 5, 1917.

During the spring and autumn of 1917 the author carried out 38 series of experimental rearings, in which he reared, under the same environmental and food conditions, for each series, lots of eggs treated by electricity or hydrochloric acid for a varying duration of time. The races used were native yellow, Chinese white and gold at their first crossing and the product of some of these crossings.

For the hydrochloric acid treatment one of the methods most generally acknowledged to be favourable was used. It consists in treating native yellow eggs with fuming hydrochloric acid diluted in  $\frac{1}{3}$  of water, during 10 minutes, and the Chinese eggs for a few minutes less.

For the electric treatment, electrification of the eggs contained in bags between the two electrodes was sometimes used, but more often "electric rain". The author has so modified this method that the eggs may be subjected directly to the "electric rain", without being placed in silk bags as was done hitherto. By this method, which will be described in a later paper, it is possible to avoid, partly at least, the drawback resulting from difference in treatment which sometimes occurs with more or less powerful apparatuses during more or less dry periods.

Of the 38 series, 10 gave results slightly favourable to the electric treatment, at least some of the lots giving better results than those treated with hydrochloric acid; 28 gave results distinctly unfavourable to this treatment for all the worms died before reaching maturity, whereas those from eggs treated with hydrochloric acid always proved much more resistant, and often gave good results. The most prolonged electric treatment appears to be the least favourable. From these experiments it was concluded that the electric treatment is clearly inferior to the hydrochloric acid treatment, which being also the more simple, should be preferred.

(1) See R. Jan., 1918, No. 76. (Ed.)

The loss of weight of the eggs treated with electricity or acid for each between the treatment and hatching was also studied. The results showed that, within the limits of complete hatching, the loss of weight is in direct proportion to the duration of the treatment, but prolonged treatment decreases it. The progress of this phenomenon will be shown by results in the author's coming paper.

Finally it is shown that, when hatching is brought about prematurely by hydrochloric acid, the eggs, though they remain strong, often give bad results on account of the excessive summer heat. This is easily explained. It is considered that annual breeds, which already suffer in hot springs, hatch in the summer with difficulty.

The special treatment cannot give new vigour to the breed; it must suffice that it does not weaken it appreciably. These methods, like that of prolonged estivation, give good results for breeding at moderate temperatures, but at very hot temperatures, breeds already adapted to these conditions must be used. Crossing with bivoltines should give the desired result. They have already been thoroughly studied with respect to their products especially the profit they give, and attempts should now be made to use them practically, by solving some of the difficulties which arise.

**Selection by Phototaxy of Newly-Hatched Silkworm Larvae with Regard to their Strength.** — ACQUA, C., in *Rendiconti dell'Istituto biologico della R. Scuola superiore di Agricoltura in Portici*, Vol. II, pp. 51-77. Portici, 1917.

In his preceding work (1) the author showed that silkworm larvae, after hatching, move towards the light (positive phototaxy), whereas, at later stages, they tend to avoid it (negative phototaxy), and that the larvae showing the most active phototaxy are also the most resistant to "flacherie". In his present work the author has restudied phototaxy on a larger scale, making numerous experiments (33) with many breeds (native yellow, Chinese white, Chinese gold, Chinese bi-yellow) reared in spring, summer or autumn. In order to separate the larvae showing a greater phototactic activity from those showing a lesser, he used an incubator with double walls, the space being filled with water, long enough to hold 8 small frames about 10 centimetres wide and 3 1/4 feet long, with two doors, the back one of wood, the front one of ground glass. A few hours after hatching, there are placed rapidly on different parts of the frames, narrow strips of mulberry leaves, or, if still, on the cloth forming the bottom of the frame, sheets of paper, whose edges overlap, like tiles of a roof. When collecting the mulberry leaves from the different parts, or the sheets of paper, the larvae which have moved most rapidly towards the light are separated from those which have moved more slowly, or not at all. The results of these 33 experiments confirm in every way those of the two preceding studies, and leave no doubt that larvae which show the greatest phototactic activity are also the strongest, grow the most rapidly, are the most resistant to disease and produce the heaviest cocoons.

(1) See R. March, 1916, No. 328; and R. June, 1917, No. 572. (Ed.)



The use of this method of selection in practice has given only negative results in attempts to test the strength of the eggs, at the beginning of spring before their distribution for ordinary rearing. This is because the phototactic reaction varies with the different breeds independently of their strength. This method is also unadapted to ordinary rearing by putting in a normally lit on one side only, a number of eggs exceeding that to be reared and rejecting the slowest-moving larvae, because the number of larvae reacting strongly to light is usually small; the bulk move more or less in a continuous line so that, considering the difference between one breed and another, the rearer has no positive indication of where he must stop. On the other hand, selection by phototaxy may be used as a means of improving breeding races in combination with the method now followed of selecting the silkworms which live longest.

196 - Studies on the Process of Digestion in Silkworm Larvae. — ACQUA, C., in *Rendiconto dell'Istituto biologico della R. Scuola Superiore di Agricoltura in Portici*, Vol. I, pp. 44 and Vol. II, pp. 31-50. Portici, 1916-1917.

By: a) the microscopic examination of microtome sections, embedded in paraffin wax, of various parts of the intestine together with the contents; b) the extraction of the intestinal juice of fasting and non-fasting larvae; c) a study *in vitro* of the properties of this juice, the author was able to ascertain:

1) that the cytoplasmic substances of mulberry leaves which are expelled from their cells by the rupture of their membranes during mastication, disappear gradually in proportion as the posterior part of the intestinal tube is approached, whereas the cells which remain intact appear to pass through the tube unchanged;

2) the starch granules show no trace of change or corrosion;

3) in the intestinal juice there are one or more proteolytic diastases similar in character to trypsin, and which, among other properties, have that of digesting coagulated ovalbumen, but it was not possible to ascertain the existence of an amylolytic ferment capable of acting on the starch (contrary to the general opinion that the starch may be utilised) or of lipolytic ferments capable of digesting the fats.

In a second study the author has re-tested the results of his first work undertaking new research: — a) on the proteolytic ferments in fasting larvae and in larvae which have taken a normal amount of food; b) on the eventual occurrence of amylolytic ferments under the above conditions; c) the possible action of the salivary glands. The presence of invertases was carefully investigated. All these studies, as well as the first ones, were confined to the native yellow breed. The results again confirm the low enzymatic content of the intestinal juice of the silkworm, in which the author notes: a) a low capacity for inverting cane sugar; b) an energetic proteolytic ferment acting in an alkaline medium (such as trypsin) on the soluble, coagulable ovalbumen, on the fibrin of the blood, on the vegetable proteins (zein). It may be concluded that the silkworm digests food principally, or even exclusively, by means of one or more proteolytic zymases, and cannot complete its nutrition by absorbing the soluble carbohydrates (sugars) of the

digested. It has been proved that neither the presence of foodstuffs in the intestinal tube, nor the olfactory stimulant, have even the slightest influence on the secretion of these enzymes. It has been proved beyond all doubt that the starch passes unchanged through the intestinal canal of the silkworm. The eventual action of lipolytic ferments calls for further study.

If the reactions which take place in the digestive canal of the silkworm are very limited from a qualitative point of view of the substances contained in the mulberry leaf, the same may be said of the quantitative point of view, the silkworm only utilises the substances expelled from the vegetable as a result of their rupture during mastication, whereas it appears that no action can take place within the cells, perhaps because of the difficulty the enzymes have to penetrate their walls. Nevertheless, the author states in his second study that, in the longitudinal sections of the intestine of newly-hatched larvae, fed at the beginning of spring on very young and very tender leaves, digestion was seen to occur, during the passage through the digestive tube, also within the cells. In newly-hatched larvae the small intestine is much more extended than at the later ages in proportion to the other parts; in the above case a beginning of digestion was also noted near the front intestine.

Consequently, the custom of giving newly-born larvae very tender leaves does not only facilitate digestion, but also facilitates the penetration of the enzymes through the cellular membranes, which, in this case, are very thin and easily penetrated.

Finally, the author made an experimental test with tubes of MERTZ (coagulated ovalbumen) on the action of the proteolytic zymases of healthy larvae and of those predisposed to "flacherie". No difference was noticed, so that it would appear that the disorders noticed in the intestinal juice of larvae suffering from "flacherie" do not precede the disease, but are a result of it. The author is continuing the study of this question.

— On Natural Parthenogenesis in Various Breeds and Varieties of *Bombyx mori* (1). — LECAILLON, A., in *Comptes Rendus des Séances de l'Académie des Sciences*, Vol. CLXV, No. 20, pp. 799-801. Paris, December 3, 1917.

This paper gives the results of experiments carried out to ascertain the aptitude for natural parthenogenesis in the silkworm varies with different breeds or varieties.

The material used was: — 1) 3 lots, each of about 400 unfertilised eggs, laid by univoltine silkworms giving straw coloured cocoons; 2) 10 lots of unfertilised eggs from accidental bivoltines; 3) 5 lots of unfertilised eggs from a Chinese polyvoltine breed.

The results obtained led to the conclusion that there is a real aptitude for parthenogenesis in all breeds of *Bombyx mori*, but there are many variations in the degree of development of this aptitude. The parthenogenetic transformations which take place in the egg may stop at a stage which appears to be extremely early, or continue till a larva is produced capable of living and developing just as well as those from fertilised eggs.

(1) See R. October, 1917, No. 936 and November, 1917, No. 1050. (Ed.)

198 — **Note on Sericulture in Madagascar** (1). — FAUCHÈRE in *Comptes Rendus des Séances de l'Académie des Sciences*, Vol. CLXV, No. 20, pp. 676-677. Paris, November 1917.

The author, being entrusted with the reorganisation of the sericulture service in central Madagascar, was able to make new observations which he reports in the present note.

The races of *Serica mori* introduced into Madagascar come from the South of Europe and were all monovoltine. After two years, by adaptation to the climatic conditions in the centre of the island, they became polyvoltine, breeding six generations a year. The cocoons are identical with those of the same races which have remained monovoltine, and the silk is of first quality. The eggs hatch regularly 12 or 13 days after they are laid, without it being necessary to subject them to the action of cold which, indeed, appears to be detrimental to them.

As in Europe, diseases are to be feared, especially pebrine; this disease is aggravated in tropical countries by the fact that the generations succeed each other throughout the year without interruption, and also on account of the negligence of the native breeders. The author observed that pebrine is less easily transmitted than is generally believed. He, therefore, made breeding from separated families a strict rule for the production of eggs at the Sericultural Station of Nanisana, near Tananarive. He perfected the method of cellular egg production as practised in Europe: the couples are placed on sheets of paper placed on strips of wood, then covered with a sort of tin funnel to prevent the eggs from mixing and, also, to obtain a large number of eggs in a limited space.

These remarks only apply to *Serica mori*, and not to *Borocera madagascariensis*, a native species of very different habits giving a coarse silk.

## FARM ENGINEERING.

199. — **Tractor Trials in Scotland in 1917.** — *The North British Agriculturalist*, Vol. LXXI, No. 49, p. 740. Edinburgh, December 6, 1916.

CULTURAL  
MACHINERY  
AND  
IMPLEMENTS

The official report of the Reporting Committee of the Highland Agricultural Society of Scotland on the tractor trials held at Edinburgh, Glasgow and Perth, in October, 1917, gives the following classification of the 29 machines that took part in the trials:

1) *Wheels*: 15 ran on 4 wheels; 6 on 3 wheels; 4 ran on caterpillars and 4 were single-unit machines.

2) *Driving*: 18 tractors were handled by 2 men, while 18 were for man outfits.

3) *Fuel*: 25 were operated by paraffin; 3 by petrol and 1 by steam.

4) *Weight*: 2 weighed over 80 cwt.; 3 over 60 cwt.; 6 over 50 cwt.; 7 over 40 cwt.; 3 over 30 cwt.; 8 less than 30 cwt.

(1) See *R. August*, 1916, No. 891. (Ed.)

The report does not class the tractors in order of merit, but it gives observations that will be of use to both farmers and engineers; these observations are given below.

**WEIGHT.** — Light machines, suitably provided with spuds, grip the ground and perform the work better than the heavier machines. Every drawback, such as slipping in soft land and inability to climb gradients, was aggravated by increase of weight above a certain limit. A heavy tractor moreover, at a disadvantage for the lighter forms of cultivation, such as ploughing, cultivating, seeding and harrowing and also for harvesting. The light tractor is quite suitable for all the farm operations, including driving a threshing-mill and other farm machinery. The only class of work for which the light tractor does not appear to be suited is road haulage. The conclusion was reached that, to suit conditions in Scotland, an efficient light tractor need not exceed 30 cwt. in weight.

**HORSE-POWER.** — For various reasons such as inexperienced drivers, loss of power due to soft ground and clogging of the wheels and moving parts with mud, etc., the tractor should have a minimum of 20 h. p., so that it can haul a 2-furrow plough under the worst conditions, and a 3-furrow plough under ordinary conditions; it should also be capable of driving a 4 ft. 6 in. threshing-mill.

**CATERPILLAR VERSUS WHEELS.** — While this arrangement distributes the actual dead weight and thus reduces the intensity of pressure on the ground, it appears certain that there must be excessive wear and tear on the caterpillar. As far as the Committee could observe the caterpillar has no advantage as regards gripping power over the best types of wheel machines.

**SPIKES, BARS AND SPUDS.** — A stout spud 3 in. to 4 in. in width and 5 in. in length appears to be more satisfactory than spikes or bars, especially when these spuds are so arranged in relation to the circumference of the wheel, that the full gripping power of one spud is always in operation.

**ACCESSIBILITY AND PROTECTION.** — The report notes the importance of rendering the vital parts of the machinery more accessible and also providing protection against the weather.

**BRAKES.** — For transport purposes, all tractors should be provided with adequate brakes.

**RELIABILITY AND DURABILITY.** — Seeing that only one machine failed to complete the 6 days' work, it seems that a fair degree of reliability has been attained. In spite of the bad state of the ground, the tractors overcame all the difficulties. Two defects were noted as tending to impair reliability. These are the exposed gear drives on some of the wheel tractors, which fill with mud and grit, and the already mentioned excessive wear of the caterpillar arrangement.

**SPRING AND OTHER CONNECTIONS.** — The Committee are of the opinion that the drawbar should be provided with some spring appliance, which would relieve the strain on the plough in the case of encountering minor obstacles. With this might be incorporated a release device, which would completely detach the plough under the strain of a heavy shock. This attachment should be an integral part of the tractor and not merely a ca-

sual device inserted in the draft connections. Provision should also be made for altering the point of attachment of the plough to the tractor in vertical direction. Thus is important as different implements require different heights of attachment.

**SPEEDS.** — It is suggested that speeds of  $2\frac{1}{2}$  and 4 miles per hour should meet the requirement of a tractor for use on the land.

**FUELS.** — Although no tests of fuel consumption could be carried out, it was found that the carburettors of many of the tractors were not capable of thoroughly and completely vaporising paraffin, and that the combustion was, in consequence, defective in many cases. Under normal conditions it may be found that petrol is more satisfactory to use than paraffin.

**PLOUGHS.** — They should be made so as to be easily adjusted to varying widths so as to suit the depths and the class of work. Automatic regulation should be provided. They should be provided with a device for regulating the width of the leading furrow.

The Committee further suggest that :

1) If the last unit of the plough could be made so that it could be thrown out of action by being raised with a lever or otherwise, then 2 furrows could be ploughed on an up gradient and 3 on a down.

2) The introduction of a one-way plough would obviate the necessity of having featherings and finishes, most of which, under present circumstances, must be performed with horses.

**HANDLING.** — The handling of the tractors did not appear to present any great difficulties. The single unit machine has the advantage that the implement operation was directly under the observation of the driver. The light tractors and single-unit machines were able to turn more quickly at the headlands.

**PRICE.** — The question of price is a difficult one under the present abnormal conditions. Manufacturers should, however, aim at putting a tractor on the market at a price not exceeding £ 300.

200 — **Ploughing and Harrowing with a Tractor.** — RINGELMANN, MAX, in the *Journal d'Agriculture Pratique*, Year LXXXI, Vol. CXXXI, New Series, Vol. XXX, No. pp. 487-489, figs. 3. Paris, December 13, 1917.

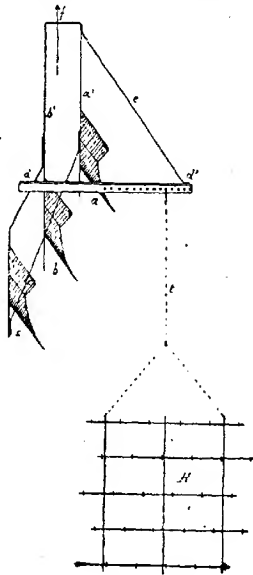
Land ploughed in autumn before sowing and especially spring-ploughed land, should be harrowed as soon as possible. With a tractor, plough and harrowing can be carried out simultaneously, by using a simple attachment to the plough.

In the appended figure, giving a diagram of a 3-furrow plough, moving in the direction  $f$ , it will be seen that the harrow  $H$  can be attached by a chain  $t$  to a suitable point of a cross bar  $dd'$ , fixed to the beams  $a'$  and  $b'$ . The cross-bar, a 60 mm. beam of wood or iron, is fixed to the beam  $a'$  and  $b'$  by bands, and strengthened by a brace-rod  $c$ . The hook of the chain engages in one of the holes of the cross-bar  $d'$ , which regulates the width. The position of the chain  $t$  should be such that the harrow  $H$  does not cut the last earth turned by the plough  $c$ ; the harrow works on the beam  $a$  and  $b$ , then the last furrows turned previously; in this way, no earth

the furrow opened by the plough *c*, and thus no interference is caused by the automatic guidance of the tractor.

The harrow should cover a greater width than the plough. After trials with the 20 HP Titan and 20 HP Mogul tractors, excellent results were

obtained with the grouping used by the "COMPAGNIE INTERNATIONALE DE TRACTEURS AGRICOLES"; the 30-tooth harrow, 61 inches wide, was attached to a 3-furrow plough covering 35 inches. According to the depth to which the harrow teeth penetrated, the average extra traction required varied from 374 to 572 lb. The use of a harrow with adjustable teeth, that can be raised with a lever at the headland, is desirable. The drag-harrow may be replaced by an "Acmé" or a disc-harrow. If the tractor is used for harrowing alone, the width of work may be increased by hitching several harrows to the drawbar. In this case, the tractor should not press heavily on the harrow, causing packing, and uneven harrowing, with a consequent bad effect on the crop. In the lack of further data on this point, the author thinks that the weight should not be greater than that of 25 kg. per cm. width of



Method of coupling a harrow to a 3-furrow plough.

A harrow frame with seat, joined to the draw-bar, is described which is mostly used in the United States. In 1886 the author had tried such a frame with a seat, built by F. PUNAT.

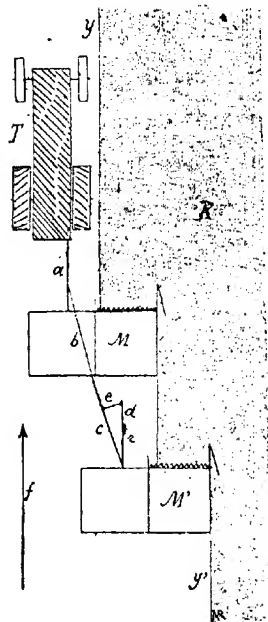
**Harvesting with a Tractor.** — RINGELMANN, MAX.: I. *Journal d'Agriculture pratique*, Year LXXXI, New Series, Vol. XXX, No. 10, pp. 366-368, figs. 3. Paris, Sept. 20, 1917. — II. *Bulletin de la Société d'Encouragement pour l'Industrie Nationale* Year CLVI, Vol. CXXVIII, No. 5, pp. 314-318, figs. 4. Paris, Sept.-Oct., 1917.

I. — Information regarding harvesting with a tractor carried out in 1917 by the "Syndicat de culture mécanique de Sencenac-Puy de Fourche (Vendée, France)", and communicated to the author by M. BIRABEU, Laborie-Fricard, a managing director of the company.

A 25 HP. Case tractor was used to draw 2 binders with 59 in. cutters. It was estimated that the tractor could have towed 3 binders on flat ground.

The appended figure shows how the machines were attached: the trac-

tor  $T$  moves in the direction shown by the arrow  $f$ , towing 2 binders  $M$  and  $M'$ ;  $R$  is the crop to be cut.  $M$  is attached to the extreme right of the tractor by a small shaft  $a$ , 59 in. long, to which is fixed a towing rod  $b$  receiving a short oblique wooden pole,  $c$  79 in. long, whose far end is joined to the base of the shaft  $d$  of the binder  $M'$ . The small shaft  $d$  is supported by a roller  $e$  and forms with  $c$  an angle held by a rod  $e$  acting as a stay. The right-hand driving wheel of the tractor passes at 10 in. distance from the edge  $y$  of the crop  $R$ . The cutter-head of  $M$  works on its full length, about 55 in., while that of  $M'$  only cuts a width of 40 in. The width cut in each turn (distance between  $y$  and  $y'$ ) is about 102 in.



Plan for coupling 2 binders to a tractor.

II. The tractor with the 2 binders working under the conditions described burns, on very undulating land, 12.10 gallons of gasoline in 16 hours to cut 151 17 acres; the whole assemblage worked for 2 consecutive weeks without stoppage.

With 2 binders attached, the corner of the field should be rounded off on a large area; thus, several machines coupled together would only be suitable for work on large areas. When the width of crop to be cut is about 100 ft., it is more economical to cut only on the 2 long sides, leaving enough space for turning at the ends, removing sheaves that impede the passage.

The author reduces these figures to the rate per hour, using his previous observations made on the 25 HP. Case tractor.

The weight of fuel burned per acre should vary about 4.6 lb., which is not excessive.

Working speed	{ per second . . . . .	35.43 in.
	{ hour . . . . .	3540 yd.
Width of cut	. . . . .	102 in.
Surface cut	{ per second . . . . .	25.20 sq. ft.
	{ hour . . . . .	66.6 sq. ft.
Actual time worked	per hour . . . . .	46 min.
Fuel burned	{ per hour . . . . .	1.10 galls.
	{ acre . . . . .	0.7 galls.

202 - The Mailliet Field and Vineyard Tilling Machine. — FRÉMIER, VICTOR, in *Le Gén Rural*, Year X, No. 74, New Series, No. 14, p. 11, fig. 4. Part 3, 1917.

M. MAILLET has changed his single unit tilling machine (1) into an agricultural motor with 2 driving wheels; in addition, he has modified it

(1) See *R. Oct.*, 1916, No. 1111. (Ed.)

vineyard-tilling apparatus. Two types are made, one of 12-15 HP., the other of 20-25 HP.

The small model is more specially designed for use with vines planted 3 to 87 in. apart. Its total length is 102 in., its width 47 in., its height 5 in. The frame, which supports the machinery (enclosed in special gear-boxes), is on 4 wheels, 2 front ones for steering, 2 rear ones for driving. The engine is in front. The gear-box is in the centre and includes 3 superposed axles; the central one works the driving wheels through the upper axle. The lower axle drives the tilling apparatus. Three speeds and reverse are provided for the machine, and 2 or 3 speeds for the tilling apparatus.

This tractor can serve many purposes as it can be used as a tractor or all the ordinary farm vehicles and implements. The appended figure shows the MAILLET tractor working between 2 rows of vines.



MAILLET Field and Vineyard Tilling Machine.

83 - The "Kardell 4 in 1" Tractor. — *The Implement and Machinery Review*, Vol. XXXIII, No. 512, p. 838, fig. 1. London, December 1, 1917.

A new tractor built by the KARDELL TRACTOR & TRUCK CO., St. Louis, U.S.A., which can perform 4 different operations: — ploughing, tractor work, motor carting and generating farm power (1).

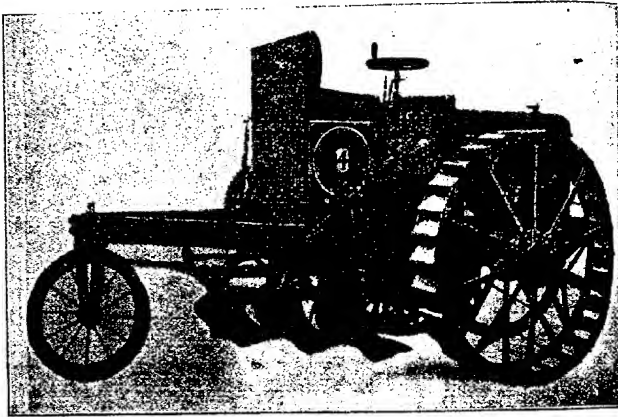
(1) *The Farm Implement News*, Vol. XXXVIII, No. 6, Chicago, Feb. 8, 1917, gives the following additional information: — weight, 5300 lbs.; 4 cylinder engine, working at 600 revs.; 35 HP stated, and 16 HP at draw-bar; fuel, petrol or paraffin; driving wheels, diameter, 60 in.; tyre width, 12 in.; price, \$ 1250. (F.D.)



It is claimed that the tractor meets all the requirements of an average farm of 100 to 500 acres, both for its simplicity of construction and strength and for the multifarious duties it can perform.

As shown in the annexed figure, the 2 driving wheels are of a new type, carrying a webbed tread, tending rather to loosen than pack the soil, and at the same time preventing slipping.

The ploughs are carried under the main frame, an arrangement which is said to reduce the draft by 33.3 per cent. Three 14-in ploughs are attached to an adjustable spring draw-bar, which automatically stops the ploughing when a rock or stump is encountered. The ploughs are so regulated that they individually follow the contour of the ground, and secure an even depth under all conditions. It is claimed that from 12 to 15 acres a day can be ploughed. The machine can be driven in either direction with ease. The ploughs can be easily removed, and the tractor used as a tractor or truck. A 20-in pulley is provided for driving stationary machinery.



"Kardell 4 in 1" Tractor.

204 - The "Eros" Tractor Plough. — *The Implement and Machinery Review*, Vol. XLIII No. 512, p. 834, 1 fig. London, December, 1, 1916.

The "Eros", manufactured by J. M. B. COLLINS, of Bacton, Norfolk, England, is a self-lift 3-furrow plough, which can be easily converted into a 2-furrow implement.

One of its most noteworthy features is a patent automatic lifting device, which utilises the forward movement of the tractor, instead of using springs. By merely pulling a cord, a small catch is released and the lifting gear automatically comes into action, lifting the plough out of the furrow when at the headland. By turning a small handle the depth of ploughing can be regulated while the plough is at work. It turns a furrow  $9\frac{1}{2}$  in wide and from 8 to 9 in. deep.

The frame is of flat steel, strongly riveted to withstand the strain tractor work. The total weight of the plough is about 6 cwt.

5. — **The W. A. Wood Motor-driven Binder.** — *The Implement and Machinery Review*, Vol. XLIII, No. 512, pp. 835-836, figs. 3. London, Dec. 1, 1907.

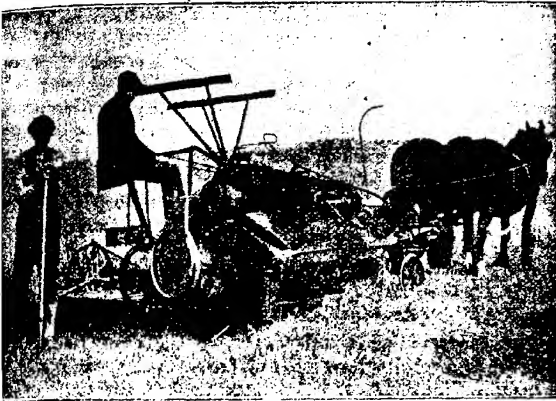


Fig. 1. — The W. A. Wood binder with a Wood motor mounted in the rear.

In the United States, motor-driven binders are more freely used than in England. During the 1917 season, binders so equipped did excellent work in Scotland. Fig. 1 shows a WALTER A. WOOD binder equipped with a Wood petrol engine.

Owing to the engine, the crop is cut more easily, especially in the case of tangled crops; the draught is also lightened, for only 2 horses are required instead of 4; moreover, the work is performed in  $\frac{2}{3}$  of the time required for an ordinary binder.

Mr. J. FERRIER, of Wick, using this machine, cut 97 acres of oat and barley in 100 hours, using only 2 gallons of petrol. Fig. 2 shows the 4 H. P. Wood engine, which can be fixed on the rear of the binder. The engine can also be used to drive any binder, potato digger

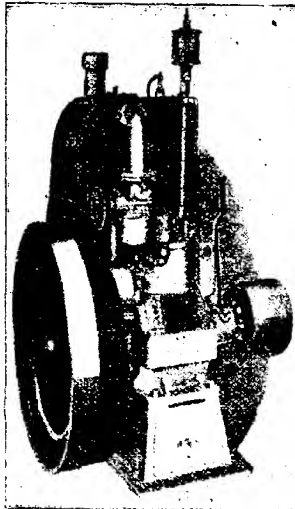


Fig. 2. — Wood motor.

or manure spreader. When mounted on a special base, it can be used for running chaff cutters, mills, circular saws, pumps, etc.

206 - **The "Balbo-Bertone" Motor Rice-Harvester.** — TARCHETTI, A., in *Il Giornale Riscicoltura*, Year VII, No. 19-20, pp. 243-247, 2 figs. Vercelli, October 15-30, 1917.

The BALBO-BERTONE side-delivery reaper is an ordinary ADRIANCE machine of which the rakes and the knife-bar are worked by an 8 HP. Felix benzol-burning engine, of Swiss make.

The machine is easily drawn by a pair of horses or oxen, the presence of the engine permitting the ordinary driving wheel of the harvester to be replaced by a lighter wheel of wood (diameter 33 in., tyre 6 in. wide and 4 in. thick) which only carries the weight. In damp and soft soils, a sledge or skate supports the machine when the tyre sinks in the ground. The sledge or skate is 6 ft. 6 in. long and placed near the wheel, nearly at the centre of gravity of the machine, so that it will slip along over the mud. Being attached almost rigidly to the beam, the skate can easily pass over dikes and ditches.

The sledge or skate, made of hollow sheet-iron, 6 in. wide, is suspended from the axle by two buffer-springs to deaden shocks against the ground. It also serves as a water-tank for the engine, an ingenious arrangement that saves space and lowers the centre of gravity, which makes the machine more stable and gives rapid cooling against the damp soil of the rice-field.

At the other end of the machine, under the knife-platform is another small spring-mounted skid, near the wheel carrying the platform, the height of which can be easily adjusted according to the height of the cut.

The knife-blade is 59 in. long; there are 4 rakes, which can work together or in part as beaters. The engine has 1 cylinder and moves the knife-bar to and fro about 250 times a minute.

Without the driver the total weight of machine with the tank full is about 1320 lbs., while the ordinary ADRIANCE No. 6 harvester weighs 910 lbs. The BALBO-BERTONE harvester is 10 ft. 6 in. wide when working and 62 in. when folded up for moving on the road. Its pre-war price was £125.

Trials with this machine have been carried out in both a transplanted and an ordinary rice field. It was drawn by 2 oxen led by a driver and a mechanic, attending to the engine and the machine, was seated. Except for the unexpected breakage of a gear during the last hour of the experiment, the harvester worked regularly, cutting cleanly, completely and evenly; the sledge worked very well, the rakes were efficient and the work was not too heavy for the oxen. Before using the harvester, an opening of about 1/2 yard should be cut in the rice with a scythe to allow for turning. With the oxen walking at 31.49 in. per second, and the width of cut being 51 in., some 4 425 sq. yds. may be harvested per hour, about 1.5 to 1.8 lb. of grain being consumed.

207 - **The Use of Wind Engines for Irrigating Semiarid Soils in the Western United States.** — FULLER, in *U. S. Department of Agriculture, Farmers' Bulletin* 566, pp. 1-3 figs. 11, tables 3, bibliography of 32 Bulletins concerning Irrigation. Washington, 1917.

This bulletin is a new and revised edition of bulletin 394, published in 1910 by the U. S. Department of Agriculture, with the object of showing

to irrigate small tracts of land cultivated without irrigation by means of wind engines. Information is given as to: — sources of water; boring hydraulic wells; power required to lift water; friction of water in pipes; method for calculating the dimensions of the wind engine to be bought.

To choose such an engine, a Meteorological Bureau should be consulted to the wind velocity over a considerable period of time. The velocity of the wind is neither constant nor regular, and may vary from 10 to 25 miles per hour in a few minutes.

Ordinary methods for ascertaining the velocity of the wind do not take these fluctuations into account, usually only indicating the average velocity. In choosing a wind engine and pump, the average velocity per hour should be neglected, attention being paid to the time during which the wind attains certain velocities per hour.

Attention should be paid to: — 1) the provision of efficient lubrication; 2) easy renewal of worn parts; 3) strong and accurate construction of the engine and its parts; 4) the reputation of the engine under consideration. Useful information is given regarding the tower, its bracing, anchoring, and construction as well as the care of the wind engine. In 2 tables, applying particularly to Kansas, Colorado, and Nebraska, the author has summarised information obtained by observing and inspecting numerous wind engines, relating to: 1) the area to be irrigated; 2) the crop grown; 3) the number of acres played; 4) the dimensions of the wind engine; 5) the capacity of reservoirs, the construction and design of which are considered in detail. Circular tanks are the most easy to build, and have fewer disadvantages. A table gives the cost of constructing circular reservoirs of suitable dimensions and capacity for the land to be irrigated.

5. **The Marcel Landrin Non-Slip Wheel.** — RINGELMANN, MAX, in the *Bulletin de la Société d'Encouragement pour l'Industrie Nationale*, Year CXI, Vol. CXXVIII, No. 5, p. 211-212, figs. 2. Paris, September-October, 1917.

The driving wheels of the MARCEL LANDRIN winch tractor (1) are of the type called "non-slip", the strakes of which, placed obliquely to the spokes, pass through openings in the tyres of the driving wheels. The strakes turn round an eccentric on the axle of the wheels and, according to the position of the eccentric, the strakes protrude at the lower part of the wheel to penetrate in the soil when the machine is working in the field as a tractor, or else protrude on the upper part when the machine is travelling on the road.

6. **Industrial Alcohol in South Africa.** — *The South African Journal of Industries*, Vol. I, No. 1, pp. 46-48. Pretoria, September, 1917.

The question of producing alcohol as a substitute for petrol as a motor fuel has long engaged the attention of the South African trade. For this purpose many products capable of yielding alcohol were examined — maize,

(1) See B. 1914, No. 557. — The *Notes de Culture Mécanique* by DR. CHAUVEAU (Paris, Librairie Baillière, 1917) gives the following data as regards this tractor: — Weight 11 000 lbs.; cylinder engine of 140 mm. bore and 150 mm. stroke, running at 800 revolutions per minute; 10 HP; fuel: petrol, alcohol, or paraffin; dimensions: 15 ft. 9 in. × 7 ft. 4 in. × 6 ft. 1 in.; front wheels and 2 driving wheels. (Ed.)

potatoes, prickly pear and cane sugar molasses — but, except in the case of the latter, no definite results have been obtained. In the molasses of the Natal sugar plantations the Union has a source of supply capable of producing an inexpensive alcohol. Up to the present, production on a commercial scale was impossible, owing to the 2 s. per gallon duty. In order to encourage the production of an alcohol to be used as fuel, the Union Government removed this duty on the condition that a satisfactory denaturant be found.

The law demands that 100 volumes of such alcohol shall contain not less than 2 volumes of wood naphtha, and at least  $\frac{1}{2}$  volume of pyridine base, if the alcohol be mixed with ether, then 1 volume of wood naphtha or benzene shall suffice for every 10 volumes of ether present.

The alcohol shall be coloured blue, green, or violet, with a stable colouring matter. The intensity of the colouration which will be accepted as sufficient is not less than that of a 5 % solution of crystallised copper sulphate.

## 210 — Review of Patents.

### *Tillage Machines and Implements.*

- France 480 424 (20 256) Soil tilling implement (1).  
 480 942 (20 399) TOURAND and DERGUESSE motorplough (2).  
 485 097. New rack regulating system for ploughs.
- Switzerland 76 514. Motor balance-plough.
- United Kingdom 110 032. One way motorplough.  
 110 198. Motor driven cultivating implement.
- United States 1 244 714 Combined colter and jointer.  
 1 244 838. Implement frame.  
 1 244 993 — 1 245 261. Harrows.  
 1 245 295. Double disc harrow.  
 1 245 613. Cultivator.

### *Irrigation.*

- United States 1 245 050. Irrigating apparatus.  
 1 245 271. Irrigation ditch cleaner.

### *Drills and Seeding Machines.*

- United Kingdom 110 094. Potato planter.
- United States 1 244 787. Seed discharging mechanism.  
 1 244 957. Maize planter.

### *Various Cultural Operations.*

- Switzerland 76 766. Drill cultivator.
- United States 1 244 531. Weeder and cultivator.  
 1 244 765. Hoe.  
 1 244 850. Wheel hoe.  
 1 244 954. Banana protector.  
 1 244 982. Rotary weeder.  
 1 245 252. Combined earth disintegrating and weeding machine.  
 1 245 541. Plant protector.

(1) See R. January 1917, No. 79. — (2) See R. February 1917, No. 181. (Ed.)

*Control of Diseases and Pests of Plants.*

- da 178 969. Animal trap.  
 ice 484 812. Driving device for sprayers and dusters, using the movement of the draft animal.  
 ed States 1 244 547. Boll-weevil trap.  
 1 244 563. Animal trap.  
 1 244 646. Weed cutting machine.  
 1 244 834. Insect destroyer.  
 1 245 258. Insect catcher.  
 1 245 706. Insect gathering and killing machine.  
 1 245 920. Weed puller.

*Reapers, Mowers and Harvesting Machines.*

- la 178 924. Stooker.  
 d States 1 244 789. Rake.  
 1 244 458. Ensilage harvester and cutter.  
 1 245 565. Gearing for peanut harvester.

*Machines for Lifting Root Crops.*

- da 178 935. Potato digger.  
 d States 1 245 526. Potato harvester.

*Winnowing Machines.*

- da 178 679. Grain grader and cleaner.

*Machines and Implements for the Preparation and Storage of Grain, Fodder, etc.*

- de 178 704. Hay stacker.  
 erlands 2 197. Fruit sorting apparatus.  
 erland 76 515 Press for grapes and other fruits.  
 76 767. Fruit crushing machine.  
 d Kingdom 110 108. Maturing fruit apparatus.  
 ed States 1 244 513 — 1 244 514 — 1 244 515 — 1 244 516 — 1 244 517. Grinding burr.

*Steering and Traction of Agricultural Machinery.*

- ed States 1 244 727. Means for converting automobiles into trucks.  
 1 245 001. Tractor belt.  
 1 245 566 — 1 245 715 — 1 245 896. Tractors.  
 1 245 708. Controlling device for traction vehicles.

*Feeding and Housing of Livestock.*

- ed States 1 244 847. Cattle food and process of making same.  
 1 245 032. Horse shoe.

*Poultry Farming.*

- ed-Kingdom 110 124. Rearing poultry.  
 ed States 1 245 041. Brooder.  
 1 245 159. Poultry roost.

*Dairying.*

- da 178 844. Centrifugal separator mechanism.  
 erland 76 554. Churn motion mechanism.  
 76 799 — 76 800 — 76 801. Churns.  
 ed States 1 245 106. Milking machine.

*Farm Buildings.*

- da 178 726. Post hole auger.  
 ed States 1 216 008. Wind mill.

*Various.*

- ed States 1 245 381. Oil can.

## RURAL ECONOMICS.

211 - Value to Farm Families in the United States of Food, Fuel and Use of House.  
 FURCK, W. C., in *U. S. Department of Agriculture, Bulletin No. 410* (Office of Farm Management), pp. 1-36. Washington, D. C., November, 1917.

The scope of this survey was to determine the value of those things which the farm furnishes to the farm family without money cost, namely the use of a house, food and fuel. The data were secured from nearly 100 families, representing widely separated sections in 14 States. Figures were gathered covering the value of all food, fuel and shelter, itemized to show what part was bought and what part was furnished by the farm. Data also were collected bearing on the value of household labour on the farm.

Following is a brief abstract of the more significant averages established by this inquiry. The figures given are based on reports from 930 families averaging 4.8 persons per family.

*Annual value of food, fuel, and use of house : —*

Average per family, \$ 642	{	Furnished by farm. . . \$ 424	(66 per cent.)
		Bought . . . . . 218	(34 per cent.)

*Annual value of food : —*

Average per family, \$ 418	{	Animal products 58 per cent.	
		Groceries . . . 25	{ From farm 58%
		Vegetables. . . 11	{ Bought . . 42%
		Fruits. . . . . 6	

*Annual value of fuel : —*

Average per family, \$ 62	{	Wood (9.4 cords). . \$ 36.30	{ From farm 54%
		Coal (2.6 tons). . . 17.85	{ Bought . . 46%
		Oil (55 gallons) . . . 6.33	

*Annual value of use of house : —*

Average per family, \$ 132.

*Annual value of housework : —*

Average per family, \$ 228	{	Furnished by family \$ 217 (95 %)
		Hired . . . . . 11 (5 %).

It was found that the average annual value of meats (other than poultry) consumed per family was \$ 107.25; of poultry products, \$ 55.40 and of dairy products \$ 98.36. (The quantity of dairy products consumed was equivalent to 2 640 quarts of milk).

Meats constitute the most important group of foods. As it increases relative to the other groups the total value of food consumed per family increases.

Those families having a relatively greater consumption of either

ies, vegetables, or dairy products use relatively less meats, and their total consumption of food is less in value.

Families living on their own farms reported higher consumption of food and a larger proportion of food derived directly from the farm than did those living on rented farms. The average quantity of fruit canned annually per family was 122 quarts; of vegetables 32 quarts. The cost of hired hands (as of hired hands) in food, fuel and house work, was shown to be \$129 per year. Thirty-one per cent of this represents cash outlay.

The survey includes the following counties and States: Oxford, Lamoille, Vt.; Otsego, N. Y., Bucks, Pa., Gloucester, N. J., Gaston, C., Troup, Ga., Mc Lennan, Tex., Champaign, Ohio, Jefferson, Wis., Montgomery, Iowa, Cloud, Kans., Cass, N. Dak., Santa Clara, Cal.

## AGRICULTURAL INDUSTRIES.

1. — **The Composition of the Fixed Acidity of Sound and Diseased Wines.** — LABORDE, J., in *Comptes Rendus des Séances de l'Académie des Sciences*, Vol. CLXV, No. 25, pp. 1017-1020. Paris, December 27, 1917.

The fixed acidity of wines is the difference between the total acidity and the volatile acidity. It is of interest to know the proportions of the various fixed acids in the results obtained by the determination of the acids as a whole. This may be done fairly exactly by the author's new analytical method (1) which divided fixed acidity into two principal parts: — 1) acidity soluble in ether-alcohol, due to lactic, succinic, malic and citric acids; insoluble acidity, including tartaric acid as cream of tartar and a slight additional acidity.

The author found lactic acid present in marked quantities in the wines studied, even in those which had not been influenced by filiform ferments. The proportion of succinic acid does not vary much, whereas the figures for malic acid differ greatly, sometimes exceeding those for tartaric acid. Citric acid is sometimes present in fairly large quantities.

Aerobic microorganisms, which cause the more or less serious diseases of wine, may cause the fixed acidity to vary considerably.

When wine turns sour, the tartaric and malic acids disappear fairly quickly, the one more completely than the other, whereas they remain more or less in bitter wine. This difference also depends doubtless on the initial composition of the wine as well as on the bacterial action; but, on the other hand, the ferments of sour wine being more active than those of bitter wine, it is possible that this action is on the lactic acid formed at the beginning, when tartaric and malic acids are absent in sour wine. Citric acid appears to resist the influence of all ferments causing disease.

(1) *Comptes Rendus des Séances de l'Académie des Sciences*, Vol. CLXV, No. 23, p. 793 (April 29).



213 - Contribution to the Study of Alcoholic Ferments. — KAYSER, E., in *Comptes Rendus des Séances de l'Académie des Sciences*, Vol. CLXV, No. 25, pp. 1020-1022. Paris, December 17, 1917.

Selected yeasts often have a great influence on the quality of fermented drinks. They also play a part in the secondary reactions, especially left on the lees for a certain time; in the alcohols obtained there are distinct differences in the various components of the non-alcoholic coefficient.

At the end of a year an analysis of the fermentation products gave the following results:—

	Quantity per litre					
	wine yeast		cider yeast		perry yeast	
	1	1 bis	2	2 bis	3	3 bis
Total acidity in malic acid . . .	5.84	10.92	6.47	10.54	6.99	10.82
Volatile acidity in acetic acid . .	0.142	0.071	0.368	0.110	0.052	0.08
Alcohol per cent in volume . . .	6.93	6.20	6.85	6.30	6.87	6.30

The same apple must, obtained from equal weights of the varieties Saulet, Lauquart, Cébin and Douce de Bretagne, was compared by adding to it a wine yeast (Champagne), a cider yeast (Calvados) and a perry yeast (Eure). Fermentation took place in six flasks, to three of which (the three) was added a sterile solution of ammonium phosphate.

The volatile acidity was composed of acetic acid and butyric acid with traces of formic acid. The addition of phosphate decreased the proportion of volatile acids. The proportion of butyric acid was higher for perry yeast and especially for wine yeast, than for that of cider, i. e., the phosphate increased the proportion of acids superior to acetic acid. It is known that phosphate also increases the amount of yeast.

The alcohols were redistilled and concentrated; their composition was found to be as follows:—

	Percentage of alcohol at 100°, in milligrams					
	1	1 bis	2	2 bis	3	3 bis
Volatile acidity in acetic acid . .	17.3	16.7	31.1	21.3	17.1	17.1
Aldehydes . . . . .	323.2	64.4	330.0	247.0	349.0	315.0
Furfural . . . . .	0.15	0.32	0.15	0.12	0.11	0.11
Ethers, as ethyl acetate . . . . .	50.8	49.3	47.9	67.3	43.4	60.0
Higher alcohols . . . . .	364.0	215.0	167.0	153.0	213.0	150.0
Non alcohol coefficient . . . . .	755.45	375.62	576.15	488.72	667.61	580.00

It is seen that the three yeasts are distinctly different. In spite of slight contact with the air all produced much aldehyde; the addition

phosphate decreased their proportion, especially for wine yeast. The ethers present in small quantities as opposed to the aldehydes, but, in the case of cider and perry yeasts, were increased by the addition of phosphate. The yeast gave most higher alcohols, cider yeast the least; phosphate increased them.

The impurities are, therefore, greatest for wine yeast, showing that a selected yeast, chosen in accordance with the aim in view, might be more advantageously used. Such yeasts must be used with a knowledge of their properties; among the various yeasts of wine and cider, there are doubtless some which would have acted differently from those used in the author's experiments without bringing in the important factor of custom.

**Contribution to the Study of the Alcohols of Cider (1).** — KAYSER, E., in *Bulletin de la Société des Agriculteurs de France*, pp. 321-323. Paris, November, 1917.

In 1916 the author reported that high temperature increased the proportion of volatile acids, aldehydes, ethers, and higher alcohols in alcoholic fermentation. In this paper he describes his studies on the influence of must, especially of its nitrogen content, on the formation of these substances.

Apple must, sterilised in the autoclave, and containing 10.4 % of saccharose, was subjected to fermentation. At the beginning of December, 1916, this was sprinkled with a strong yeast *a* and an apiculatoid cider yeast. The experiments were made in three flasks which, when sprinkled with yeast, were left in a cupboard at room temperature, which varied from 12° C. They were, thus, subjected to all the variations of the winter 1916-1917. Fermentation was slow.

In March 1916, i. e. 3 1/2 months later, the liquid in the two flasks A and B was poured into two similar flasks. The operation was carried out aseptically, and care was taken not to disturb the lees at the bottom. The liquids were analysed (enough for this purpose remained at the bottom of the flasks, on the lees).

The contents of flask A were poured into an empty, sterile flask, A'; the contents of flask B into a flask, B', which contained the same must fermented with a third yeast, *b*.

The experiment was continued: — Flask A, without yeast, flask B with yeast *a* from the beginning, flask C in contact with a new yeast which still to finish its secondary fermentation.

In spite of the precautions taken during pouring, a few globules of yeast *a* passed into the flasks A' and C'.

The experiment was interrupted after 6 months; i. e. towards the middle of June and the fermented liquids analysed. Corresponding alcohols were obtained by heating. Table I (on the following page) gives the results obtained.

These results show that fermentation was not quite identical, at the same moment, in the three flasks, although all the conditions were the same. This is often observed in laboratory experiments.

(1) See R., December, 1916, No. 1320. (Ed.).

TABLE I. — *Results of analysis of the fermented liquids (per litre).*

	After 3 ½ months		After 6 months		
	A	C	A'	B	C'
Total acidity (sulphuric acid) . . .	2.48 gm.	2.29 gm.	2.75 gm.	2.71 gm.	2.73 g
Volatile acidity (acetic acid) . . .	0.598 gm	0.501 gm.	0.678 gm.	0.534 gm.	0.427
Alcohol % in volume. . . . .	4.6°	4.20°	6.26°	6.50°	5.70°
Reducing matter. . . . .	20 gm	31.1 gm	9 gm.	4 gm.	22

It should be noted, in particular, that the quantity of volatile acid has decreased for C' between the first and second analyses. It should also be noted that after 3 months of this slow fermentation, on account of the temperature, there still remained some undecomposed sugar, present in larger proportion in C than in A, and that, even after 6 months, in spite of the presence of an active, re-invigorated yeast, there was still a good proportion of reducing matter per litre.

TABLE II. — *Analysis of the alcohols obtained.*

	Quantity per cent of alcohol at 100° in milligrams		
	A'	B	C'
Volatile acids (acetic acid) . . . . .	94	51	46
Aldehydes . . . . .	69	8.40	57.6
Furfural . . . . .	0.6	0.32	0.44
Ethers (ethyl acetate) . . . . .	89	97	110
Higher alcohols . . . . .	55.3	44.5	68.20
Non alcohol coefficient . . . . .	307.9	201.22	282.54

Table II shows that flask B. is the poorest in higher alcohols and aldehydes. It seems, thus, that decanting, which facilitated aeration, increased the content in higher alcohols and the formation of aldehydes. Decanting on to a new yeast decreased the volatile acidity and increased the ethers.

The non-alcohol coefficient, i. e. the total amount of impurities, highest in flask A', from which the lees were most carefully removed. The non-alcohol coefficients are inferior to those obtained in practice in impure fermentations; this is not surprising.

Below are the usual ratios obtained from the study of the alcohols

Flask	Ethers	Ethers	Total
	Acids	Higher alcohols	Alcohols + Ethers
A'	0.94	1.6	144.3
B	1.9	2.2	141.5
C'	2.3	1.6	178.5

The ratio  $\frac{\text{ethers}}{\text{acids}}$  increases from  $A'$  to  $C'$  because the volatile acids decrease without there being a proportionate increase in ethers. The proportion  $\frac{\text{ethers}}{\text{alcohols}}$  is the same for the flasks  $A'$  and  $C'$ , being higher for the decanted flask, which has a lower content of higher alcohols.

The total "alcohols + ethers" is highest in the flask  $C'$ , where the secondary fermentation was made with a new yeast. It is thus possible to the influence of the new yeast, as well as that of an almost complete absence of yeast, in other words, the effect produced by decanting flasks  $A$  and  $C$ .

There is no doubt that in practice the results would have been similar, but, perhaps, less marked differences.

These experiments also show that cider for drinking and cider for distilling must be treated differently. It is clearly not a question of diseased ciders, with which frequently the only thing to be done is to turn them into alcohol. It is also probable that the variety of yeast is of great importance in this point of view.

**The Production of War Alcohol with Perry Pears.** — TRUELLE, A., in *Comptes rendus de Séances de l'Académie d'Agriculture de France*, Vol. III, No. 31, pp. 913-924. Paris, October 17, 1917.

Most of the early and semi-early perry pears become over-ripe very early. It is, therefore, necessary, to make the best use of them, to apply rational treatment which will delay over-ripening as long as possible — storage at a low temperature by piling in well-ventilated lofts, or better still, spreading in the open air on faggots in a shed or under a roof sheltering them from the rain and sun. The piles must not exceed a height of  $\frac{1}{2}$  to  $2\frac{1}{2}$  inches. The fruit must, moreover, be very carefully watched as to note when it begins to turn sleepy, so that it may be used, at the best, before the endocarp is attacked.

The best use of sleepy pears is to turn them into alcohol, but this can only be done by means of suitable treatment of the fruit and juice. It is particularly important that the clear juice ferment rapidly and completely — the use of leaven or pomace prepared with native yeasts, or selected yeasts.

To obtain a clear juice the sleepy pears must be pressed in separate rows, not more than 4 to 6 inches thick, inclosed, if possible, between thick boards and separated one from the other by draining-hurdles, or, in the absence of canvas and hurdles, by beds of long straw, or very clean reeds. If, at the first pressing, the residue contains many fragments of pulp, it is crushed; otherwise it is crumbled and pressed again; in no case is it diluted with water. The two juices obtained are put in a very clean, unfumigated cask and sprinkled as soon as possible.

The leaven is prepared with two leavens, 20 to 30 litres of mother leaven, and about 100 litres of a stock leaven; it is this latter which is finally added, the first being used to prepare it. : —

The technique of the method used by brewers to prepare the leaven is

described and emphasis is given to the necessity of distilling so as to produce the greatest quantity of well flavoured alcohol of the highest quality. The most reliable method of succeeding is to use a rectifying still, giving alcohols of 60° to 75°, passing over first,

The author comes to the following conclusions : —

From a chemical point of view, sleepy pears contain less sugar, tannin and acid than sound pears, but more pectic matter. From an economic point of view, considering only two important factors influencing their value — gross weight and sugar — during over-ripening they lose much weight, the loss varying, according to the variety and duration of over-ripening, between  $\frac{1}{11}$  and  $\frac{1}{8}$  of their total weight, and between about  $\frac{1}{8}$  and  $\frac{1}{10}$  of their total sugar content. Such a loss, expressed in 100° alcohol, is equal in round figures, to a deficit of from 7 to 25 litres per metric ton of sound pears.

Under present conditions, so as to lose nothing which may be of use to the national defence, every grower should turn his sleepy pears into alcohol. This is, nevertheless, only a means of avoiding total loss as, otherwise, such pears have no commercial value, but it is of far greater importance to them while they are sound as then they yield a better and more abundant product.

216 — On Chalk Bread. — LEPICQUE, L. and LEGENDRE, R., in *Comptes rendus des Séances de la Société de Biologie*, Vol. LXXX, No. 10, pp. 896-897. Paris, December 8, 1927.

With reference to M. RAPHAEL DUBOIS' note (1) in which he proposes to add to coarsely bolted flours used in breadmaking calcium carbonate instead of caustic lime water which he said "kills the yeast", the authors state that, in their opinion, caustic lime is preferable.

Lime water, they say, does not kill the yeast, save when mixed with directly before it is added to the dough. If, however, the amount of kali is so calculated as to neutralise the flour incompletely, the lime method gives the dough a slightly acid reaction which appears to be the optimum condition for the yeast, whereas the acid fermentations are inhibited by preceding decrease of acidity. When the leaven only is used there is danger, with lime water, of exceeding the point of neutralisation. If the leaven is strengthened by the addition of grain yeast, it is sufficient to dilute this yeast in tap water; it is then added to the dough, from which the alkalinity of the lime has disappeared.

The difference between the quantities of chemical product added is with lime water, a maximum of 30 egms. per kilogram (2.2 lbs.) of flour, with calcium carbonate, 15 to 20 gms.; even if reduced by half this proportion will doubtless appear excessive for a food such as bread.

217. — Milling and Baking Tests of the New Wheat "Kanred", in Kansas, U.S.A. — See No. 159 of this Review.

(1) See R. January, 1918, No. 3. (Ed.)

— **The Cotton Industry in China.** — From the "North China Herald" in *The Agricultural Journal of India*, Vol. XII, Part IV, pp. 658-661, Calcutta, October, 1917.

China's importations of cotton from foreign countries are increasing and will continue to increase, because the finer yarns cannot be spun from Chinese cotton. Shensi cotton, which is an American strain introduced into China, is about the only Chinese cotton that can produce a finer yarn than the American; and at the same time obtain a satisfactory production; and what China needs is more cotton of the Shensi type, or finer.

China's export cotton trade is a considerable one and about half of the sorted cotton goes to Japan.

There is a special grade of cotton peculiar to Shantung in much demand in America, where it is prepared as medicated cotton, for which it is especially adapted, as it is so white that it requires no bleaching. It is a short and harsh to the touch, so it makes an admirable imitation wool, but when used alone or mixed with wool in the manufacture of cheap hosiery and underwear.

Considering the remarkable growth of the local spinning and weaving industry during very recent years, it is only reasonable to expect that there will be Shanghai developed into the Manchester of the Far East, provided, however, that the manufacturers are given reasonable protection so that they may be allowed to compete on a fair level with foreign mills. Even with this protection, the possibilities for expansion seem almost unlimited when it is considered that all of China's millions are clad in cotton clothing. That there is ample room for vast increase in the number of power-driven spindles and looms, may be judged from the following estimated figures for the three Far Eastern countries interested in cotton mills:

	Population	Spindles	Looms
China . . . . .	400 000 000	1 050 000	5 000
India . . . . .	275 000 000	6 400 000	28 000
Japan . . . . .	52 000 000	2 174 541	21 000

Japan, a non-cotton growing country, has succeeded in developing the cotton industry to such an extent in 25 years, through a protective tariff, which places raw cotton on the free list and heavily taxes manufactured cotton when imported.

Modern cotton manufacturing was introduced into China in 1890 and extended considerably in 1896 and 1897, when foreign capital was put into local mills. Up to 1902, however, there were no returns on the investments, owing to the rapid increase of spindles and the inefficient supply of native cotton, which was not equal to the demand, and the fact that the price of raw cotton, because of the shortage, increased out of proportion to the price of yarn. The demand for the raw material, however, was met by increased acreage, and the mills have been more prosperous during recent years.

Since the organization of the Shanghai Cotton Testing House in 1911, testing of cotton against water and other adulteration has led to very official results during the past few years. The associated mills, under the

rules of the House, are not allowed to accept cotton carrying over 15 per cent. water, and an effort is being made to keep the moisture down to 12 per cent.; the natural moisture carried by American cotton is 8 per cent., and in China commonly it is 10 per cent. although Shensi cotton is naturally as low as 9 per cent.

China grows cotton and exports half to Japan, whence it is returned in the form of yarn and cloth which could be made in China. When the mills in Shanghai use Shensi, Shantung, Hupeh, or other cotton not grown in this province, at the port of entry the customs levy a duty of HK. Tls. 0.35 per picul (1), and again HK. Tls. 0.175 per picul import duty at Shanghai, in all HK. Tls. 0.525. The mills naturally avoid, so far as possible, using cotton from other than their own districts, with the result that a large part of the crop raised in provinces not adjacent to Shanghai is exported and returned to China in manufactured goods. The demand for foreign cotton, which is indispensable for certain purposes, is increasing annually, but the duty the mills have to pay on the imported cotton constitutes a considerable obstacle to the further development of the industry.

219. — Paper Making with *Ailanthus Wood*. — See No. 170 of this Review.

220. — Industrial Uses of Sweet Sorghum (Coloring Matter from the Glumes, etc.) — See No. 172 of this Review.

INDUSTRIES  
DEPENDING  
ON ANIMAL  
PRODUCTS

221. — Investigations into the Proteolytic Activity of Lactic Ferments (2): — III. The Influence of the Method of Milk Sterilisation; IV. Lacto-culture in the Selection of Lactic-Proteolytic Ferments. — GORINI, COSTANTINO, in *Atti della Reale Accademia dei Lincei, Ser. V, Rendiconti di Scienze fisiche, matematiche e naturali*, Vol. XXVI, Pt. 2, and 8, pp. 195-199 and 223-227. Rome, 1917.

The increasing importance of lactic ferments, not only in agriculture (cheese industry, silage), but also in medicine (surgical and intestinal infections) should induce workers to continue to study the differentiation and selection of species best adapted to particular functions and to cultivate them so as to obtain the greatest possible benefit.

As the author showed long since, the lactic ferments differ less in their morphological characters than in their bio-chemistry, so that one ferment cannot be used indifferently for another in cheese making or in ensiling fodder.

Apart from their acidifying capacity lactic ferments also possess another very interesting faculty — their proteolytic activity, to which the author has already drawn attention by pointing out its scientific and practical importance for either the ripening of cheese or silage or for intestinal bacteriotherapy. The proteolytic activity of lactic ferments has been largely misinterpreted as a result of unsuitable experimental conditions. Since the author has made known the inhibitory influence exercised on this activity under such conditions (especially the incubation temperature and

(1) The Hai-Kwan-Tael of the Customs weighs 37.72 grams and had in 1913 an average value of 3.81 fr. A Pikul of 100 chin is equal to 60.453 kg. (Ed.)

(2) See also R., Jan., 1916, No. 109; R., Feb., 1916, No. 232 (Ed.)

nature of the culture medium), other workers have modified and rectified in opinions, and types of lactic ferments formerly considered to have no tonising power are now acknowledged to possess it.

Another source of error which must be eliminated is the excessive temperatures generally used when sterilising milk for lactic ferment cultures, these turn the milk brown and affect the casein. Milk sterilised too long or at excessive temperatures is not suited to the casein-peptonising action of lactic ferments. (This is probably one of the motives causing workers to disagree with the author as to the importance of certain bacteria in cheese, the udder, etc.).

To make an exact study of the biochemistry of lactic ferments the milk must be sterilised with precautions which, as far as possible, will enable it to keep its white colour. This result may be obtained with an autoclave, better still, a current of steam, at a temperature not exceeding 100° C. by fractional sterilisation for 1 to 20 minutes during 3 consecutive days. It would be preferable to use temperatures below 100° C., but in this case milk must be taken aseptically. In all cases the sterilised white milk must be carefully examined to make sure it is free from microorganisms.

Only when, by the improved cultural technique devised by the author, has been possible to separate and set in motion the proteolytic capacity of a given lactic ferment, will it be possible to differentiate this ferment, for the selector to appreciate and utilise it either in agriculture or medicine, where, not only the acidifying capacity, but also the products of autolysis (albuminoids, peptones, amino-acids) of the ferments used must be taken into consideration.

**The Dairying Industry in South Africa.** — BAYNES, JOSEPH, in *The South African Journal of Industries*, Vol. I, No. 2, pp. 124-126. Pretoria, October, 1917.

Of recent years the dairying industry in South Africa has progressed considerably. Whereas, in 1906, the Union imported 11 273 748 lb. of milk, in 1909, 4 512 805 lb., in 1912, 4 025 188 lb., in 1915, 2 026 258 lb., in 1916 the importation was reduced to 267 896 lb., and, up to the end of 1917, 2 3/4 million pounds had been exported to the London markets. The number of manufacturing dairies had risen to 53, that of the collecting centres to 10 in active operation. The cheese industry has made similar progress to a small extent; the importation of cheese fell from 5 586 244 lb. in 1913 to 2 028 508 lb. in 1916, and is continually decreasing. South Africa now produces over two million pounds of cheese equal in quality to the best imported cheese.

It seems that before long the condensed milk industry will make such progress as to render unnecessary all importation of this article, which before the war reached a value of £ 500 000.

Moreover, pig-breeding and the production of bacon and lard, the importation of which reached a value of £ 224 614 in 1916, may in future be made independent of outside help, especially if the farmers perfect the methods and produce a sufficient supply of suitable material for the bacon factories which are about to be established.



New Zealand is quoted as an example for South African farmers, this colony, with a smaller population than the Union, exported in 1914 42 000 000 lb. of butter, not to mention the other products for which it is famed. The price of good dairy land in New Zealand today is about £ 30 per acre, a price much above those realised in South Africa, where the land may well bear comparison with that of New Zealand in fertility and productivity.

The development of the dairy industry in South Africa still demands great attention with regard to the improvement of dairy stock, sweet cream and winter feeding. The movement for cow-testing associations should be encouraged in every way, so that farmers may be convinced that it is more advantageous to keep one good cow than three inferior ones.

The production of the best quality cream is of vital importance in the industry if South Africa is to compete satisfactorily with the other Dominions in superior quality products. The Dairy Bill, now under consideration, when passed, will control the improper grading of dairy products and protect alike the farmer, manufacturer and exporter against fraud.

223 - **Photographic Analysis of Dried or Fresh Eggs.** — I. E. ROY, GEORGES A., in *Comptes Rendus des Séances de l'Académie des Sciences*, Vol. CLXV, No. 25, pp. 1026-1028. Paris, Dec. 17, 1917.

In the trade, to differentiate eggs as regards freshness or more or less good state of preservation, the caudling method is used i. e., an optical examination by transparency, based chiefly on the size of their air space.

For legal purposes, the author devised a new method which is more exact, allowing the size of the air space to be gauged; and a graphic record to be taken, so as to form a convincing proof, which will be both lasting and suitable for purposes of comparison. The result is obtained by photography, together with special adjustment of the light and arrangement of the eggs, which are fully described, and extremely sensitive plates. By this method it is possible to obtain life-size photographs, by transparency of groups of eggs and their air spaces, which may be measured by a graph placed over, or forming part, of the photograph.

The use of radiography for this purpose only gives deformed images very inferior to those obtained by the photographic method.

224 - **Dried Eggs** (1). — LINDER, in *Comptes Rendus des Séances de l'Académie d'Agri-culture de France*, Vol. III, No. 40, pp. 1116-1119. Paris, December 19, 1917.

For some time past there have been on sale at Paris dried eggs from Hang-Tcheou (China), where an American factory, using a method already practised in Chicago, has been established.

The author does not know the method adopted, but does know that the water is evaporated at a temperature below 50-55° C. Egg albumen coagulates at 50-55°, and the author found in these eggs a quantity of uncoagulable soluble albumen, representing 30 % of the dry product, whereas egg of normal composition have from 36 to 37 %; the albumen, therefore,

(1) See also R. 1916, No. 1221. (Ed.)

to coagulated. To obtain a commercial evaporation at 50-55° C a mercury depression of 65-70 cc. is required; evaporation is, therefore, tried out in an almost complete vacuum. It is possible that a procedure adopted similar to that proposed by MESSRS. BEVENOT and LENEVEU for the dessication of milk, which consisted in powdering the milk in a chamber the walls of which were heated.

The composition of these eggs is identical with that of normal eggs exposed to be dry. The author found 46.9 % of nitrogen, 42.4 % of fat; 3.5 % of salts; 7.2 % of moisture. The fact that the nitrogen and fat are present in almost equal proportions shows the eggs to be whole. The product contains no antiseptic.

One box contains the product of 12 eggs, weighing 150 gms., that is say 139.2 gms. of chemically dry eggs, equal to 530 gms. of fresh eggs, or 12 eggs of 45 gms.

This egg powder will not keep an indefinite time; the fat easily becomes rancid. The product is shipped in refrigerators, and, while awaiting sale, is kept in cold storage at Clichy.

In the military hospitals of Paris, the chemists of which have all given a favourable report, these dried eggs are largely used and greatly appreciated.

- **Production and Use of Pigskin.** — See No. 191 of this Review.

- **The Handling and Storage of Spring Wheat.** — BAILEY, C. H., in the *Journal of the American Society of Agronomy*, Vol. IX, No. 6, pp. 275-281, 5 diagrams. Washington, D. C., Sept., 1917.

Certain factors influencing the handling and storage of grain depend greatly on whether it is handled in bulk or in sacks. The storage of grain in bulk reduces the change in moisture content which is chiefly dependent on the climatic conditions prevailing between harvesting and threshing. If this period is warm and dry the grain will be well cured when it is sent to the consumer, but, if rain falls on the unthreshed bundles, especially shocks, the wheat will be damp and tough, and, consequently, more difficult to handle and store.

Wheat assumes the temperature of the surrounding medium more rapidly when stored in sacks than in bulk, so that, in the first case, it is less subject to injury from fermentation.

Spring wheat is not biologically ripe at the time it is usually harvested. The process of ripening after the harvest is accompanied by certain peculiar phenomena. If the bundles are in a stack they absorb the moisture. This process, commonly called "sweating", is undoubtedly accompanied by chemical changes resulting from enzymic activities within the kernel. In this sweating process occurs in normal wheat in the bin, a slight rise in temperature may result. The baking quality of the flour is improved by these changes in the grain.

Several factors determine the keeping quality after sweating; the most important of these is its moisture content at the time of storage. It is probable that, in dry grain, the amount of water absorbed is not sufficient

to produce a gel, *i. e.* the colloidal material does not have a continuous structure, thus greatly reducing the possibilities of diffusion.

The exact percentage of moisture below which this discontinuous structure exists is not known; it probably varies with the percentage of gluten in the grain as gluten has a greater water-absorbing power than starch. Increasing the moisture content above the maximum at which discontinuity exists results in the formation of an elastic gel through which diffusion can take place. Further increases in moisture content up to saturation (maximum absorption) produce progressively less viscous gels with a corresponding increase in the rate of diffusion. Since the rate of respiration in grain doubtless depends in part on the rate of diffusion between the various kernel structures, it follows that the less viscous the gelatinous material of which the cell contents are composed, the more rapid is the production of heat through respiration. For these reasons the susceptibility to heating of grain stored in the bulk is largely determined by its moisture content.

To ascertain the percentage of moisture which spring wheat may contain without heating in store, the Minnesota Grain Inspection Department and the State Board of Grain Appeals, in cooperation with the Division of Agricultural Chemistry of the University of Minnesota, made observations on the wheat stored by one of the large elevator companies. About 20 lots of wheat, containing from 12.76 to 17.45 % of moisture, were examined. The observations lasted over a year, from one summer to the following summer. From the results it was concluded that hard spring wheat, of reasonable plumpness, containing less than 14.5 % of moisture is not likely to heat when stored under normal conditions in a temperate climate, whereas similar wheat, containing 15.5 %, or over, of moisture is practically certain to heat. Between these limits the possibilities of heating depend on the following conditions: — the percentage of moisture, temperature of the atmosphere, position of bin in the elevator (the grain keeps better in the outside bins than the inside ones), material of which the bin is constructed, initial temperature of the wheat (the curve illustrating the acceleration of respiration with a rise in temperature is logarithmic), size or dimension of the bulk, etc. In uniformly mixed wheat the highest temperatures are usually near the surface; when the surrounding air is cold, as in midwinter, the maximum temperature is usually from 15 to 20 feet below the surface; in mild or hot weather, it is found at a depth of from 5 to 8 feet.

227 - *Substitutes for Tin Cans.* — *The Tea and Coffee Trade Journal*, Vol. XXXI No. 6, pp. 536-540. New York, June, 1917.

Owing to the shortage of tin and the consequent inability of tin can manufacturers to meet fully the needs of their customers, attempts have been made to replace this metal by various paper, fibre and composite products. Manufacturers of such materials declare that their boxes preserve and carry dry products as well, and in some cases better, than all-tin boxes. The type of packing now in use may be divided into five: —

1) *Cardboard.* — This is now generally used for packing tea and coffee, especially for medium qualities, many firms reserving their tin boxes

or the best qualities only. It has been said that coffee packed in cardboard loses its aroma, but this may be prevented by the use of impermeable rappers. The increasing popularity of cardboard is undoubtedly due to its low cost and adaptability to modern packing machinery.

2) *Paper*. — In spite of its increasing price paper is the cheapest rapper now on the market. It may be made very attractive and is being used more and more extensively every day. It is regularly used for flour, cereals, spices, cocoa, chocolate, drugs and sugar.

3) *Fibre*. — This class includes the cylindrical box used by the QUAKER OATS COMPANY; it is made entirely of fibre board with a slip cover. As the fibre is not treated in any way, a liner is usually considered necessary. This packing may be made to look practically like a tin box, and is much in demand by manufacturers who wish to imitate as nearly as possible the old tin cases.

4) *Paraffined fibre*. — Paraffined packing is rapidly coming to the fore. All the models have an outer covering of paraffin, the manufacturers claiming to have special processes by which the paraffin is made to penetrate the pores of the paper. These cases are substantial in appearance and are made in a variety of shapes. It is claimed that the paraffin adds considerably to the flavour-retaining properties of the package, as well as making moisture-proof.

5) *Composite*. — By this name are known boxes of fibre with tin tops and bottoms. This model is made in various shapes and combines the advantages of cardboard with those of tin. The metal parts increase the rigidity and durability of the packing, whereas the fibre sides eliminate the necessity of labelling by allowing designs and lettering to be stamped on the material.

The shortage of tin has also increased the demand for wood and fibre rapping cases. There are many models in sizes varying from 25 to 200 lbs. capacity. The prevention of loss through moisture or odour is specially noted.

A list of American manufacturers of boxes in cardboard, paper, fibre, etc. is given.

## PLANT DISEASES

### DISEASES DUE TO FUNGI, BACTERIA AND OTHER LOWER PLANTS.

228 - Fungi from Tropical Africa, California and New Zealand. — WAKEFIELD, E.M., in *Royal Botanic Gardens, Kew, Bulletin of Miscellaneous Information*, Nos. 7 and 26, pp. 308-314, figs. London, 1917.

The paper under review includes eight species of fungi, known or suspected to be parasites. Three of them, *Polyporus coffeae*, *Helicobasidium longisporum* and *Cercospora cannabina*, occur on economic plants, and may prove to be of some importance. The parasitism of the two first has not been proved, but it is possible that *Helic. longisporum* at least may be capable of causing injury. The specimens examined by the author are the only ones reported so far.

The list includes the following species, the diagnosis of which is given in latin:

1) *Polyporus Coffeae* Wakef., at the roots of a dead coffee tree at Kampala (Uganda); it is suspected of having caused the death of the tree; the fructifications were found surrounding the collar of the plant, the roots of which were encrusted with a layer of white mycelium mixed with sand; on this crust were conidial fructifications which may be connected with the *Polyporus*;

2) *Amauroderma infundibuliforme* Wakef., on the ground beneath a dead tree, Bumpenge Forest (Uganda);

3) *Hexagonia subvelutina* Wakef., on wood, in the East Africa Protectorate;

4) *Helicobasidium longisporum* Wakef., on roots of *Theobroma cacao* in Uganda, the affected roots show internal mycelium, especially along the medullary rays; Mr. W. SMALL, who found the fungus, is inclined to consider it parasitic;

5) *Tilletia Wilcoxiana* Griffiths, on a specimen of *Stipa eminens* var. *Andersonii* Vasey, from Santa Catalina Island (California), and preserved in the Kew Herbarium;

- 6) *Uromyces Secamonae* Wakef., on leaves of *Secamone platystigma*, Uganda;
- 7) *Puccinia Hoheriae* Wakef., on leaves and stems of *Hoheria popul-*  
(Lacebark), New Zealand;
- 8) *P. Berkheiae* Wakef., on leaves of *Berkheya Spekeana*, in Uganda;
- 9) *Puccinosira Dissotidis* Wakef., on leaves of *Dissotis incana* and  
*sotis* sp., in Uganda; this is the only species of *Puccinosira* for which  
aecidium stage has been described (*Aecidium Dissotidis* Cooke);
- 10) *Cercospora cannabina* Wakef., on leaves of *Cannabis sativa*, in  
Uganda.

- Selected Danish Barleys Resistant to *Ustilago Hordei*, *U. nuda* and *Septoria graminum*, Introduced into the United States of America. — See No. 138 of this Review.

- A Rust-resistant, Danish *Festuca elatior*, Introduced into the United States of America. — See No. 138 of this Review.

- "New Era", a New Zealand Potato Resistant to Mildew. — See No. 138 of this Review.

- On Forms of the Hop (*Humulus Lupulus* L.) Resistant to Mildew (*Sphaerotheca humuli* D. C. Burr.) (1). — SALMON, E. S., in *The Journal of Agricultural Science*, Vol. VIII, Pt. 4, pp. 455-460. Cambridge, December, 1917.

In certain seasons, such as 1916, very severe losses are caused to the crop by attacks of the mildew *Sphaerotheca Humuli* (DC) Burr. Within at years the hop-mildew has also appeared in epidemic form in the United States. The fact that certain forms of the hop-plant are very resistant to *Sph. Humuli* is, therefore, of great scientific and economic interest.

While the morphological species of *Sph. Humuli* attacks a very large number of host-species belonging to many different genera, experiments have proved that a specialisation of parasitism has taken place, and that the form on *Humulus* constitutes a "biologic form" with the power, so far as is known, of infecting only species of this genus.

Resistance to hop-mildew was first observed during the summer of 1914 at the South-Eastern Agricultural College, Wye, Kent. Several hundred one and two year old seedling hops were grown in pots in a greenhouse under conditions which ensured their being attacked by mildew. These plants, two proved immune throughout the growing season in spite of repeated attempts to infect them directly and indirectly. These plants were grown from seed of a hop found wild in hedges at Vittorio Veneto, (Italy) collected in October 1913 by Prof. P. A. SACCARDO. About other seedlings of the same origin, the same age and grown under conditions identical with those of the first two, proved very susceptible to mildew. During 1916 the same resistance to mildew was noticed in 7 others of same Italian origin and of the same age as the immune plants observed in 1914. Whereas these seven plants remained immune throughout the

<sup>1)</sup> See also R. Dec., 1917, No. 1142, (Ed.)

growing period, 150 seedlings of the same age and origin, grown in the same greenhouse, proved very susceptible to mildew.

The same complete immunity was shown in 1916, under the same conditions, by three plants of a form of *Humulus Lupulus* with yellow leaves received, under the name of "golden hop", from Messrs. Bide and Son of Farnham, who had bought it from Mr. G. Benard of Orleans.

The two seedlings found to be immune in 1914 were planted out during the winter 1914-15. They developed normally and, in 1916, flowered; it was then seen that one plant was male, the other female. Throughout the summer and early autumn these seedlings showed no trace of mildew although all the surrounding hops were attacked. Nevertheless, by October 3, a few leaves and flowers of a late shoot of the female plant, and two leaves, each on one of two late lateral shoots of the male plant, showed small patches of mildew.

In 1902, NEGER pointed out the possibility of the existence of "immune races" among host-species susceptible to mildew, and described instances where individual plants of *Spiraea Ulmaria* and *Epilobium montanum* resisted all infection from the conidia of *Sph. Humuli* which had developed on the same host-species.

According to Prof. KINGO MIYABE, the "biologic form" of *Sph. Humuli* which attacks *Humulus* does not exist in Japan, although the species *Sph. Humuli* is very common there on a certain number of host-species belonging to different genera. In 1916, the author received from Prof. MIYABE specimens of the male plant of the wild hop of Japan (*H. Lupulus* var. *cordifolius* Maxim). When grown in the greenhouse where, as already stated, the conditions were favourable to inoculation by conidia of the form of *Sph. Humuli* which lives on hops, the plants were infected.

A similar case is undoubtedly that of the "immunity" of Virginia creeper (*Vitis hederacea*) in Europe. In the United States this plant is attacked by vine mildew (*Uncinula necator* [Schwein.] Burr.). This mildew very common in Europe on cultivated vines, but, within the author's knowledge, has never been found attacking Virginia creeper, doubtless because specialisation of parasitism has occurred in the species *U. necator* and the "biologic form" attacking *Vitis hederacea* has not yet reached Europe.

At the present time there are no restrictions in England on the importation of *Vitis hederacea* from America. To protect this plant from the danger of being attacked by mildew, the English authorities should prohibit this importation or inspect the imported plants closely.

233 — "K'nei 'li tzu", a Chinese Chestnut Resistant to the "Ink Disease", introduced into the United States of America. — See No. 125 of this Review.

234 — Patents for the Control of Diseases and Pests of Plants. — See No. 210 of this Review.

235 — Disease and Pests of Lucerne in the Oasis of Tripoli. — See No. 163 of this Review.

[232-235]

**The South American Hevea Leaf Disease in Trinidad.** — RORER, J. B., in *Bulletin of the Department of Agriculture, Trinidad and Tobago*, Vol. XVI, Pt. 3, pp. 128-129. Port of Spain, 1917.

In July, 1916, the author's attention was called to a disease of the latex-bearing trees (*Hevea brasiliensis*) which was causing considerable defoliation on many different estates in widely separated parts of Trinidad. Microscopic examination showed the disease to be the South American Hevea Leaf Disease, which, judging by its general distribution, must have existed in the island for several years, but only became epidemic in July, August and September, 1916, when the climatic conditions were exceptionally favourable to fungous growth.

The disease was first reported in Surinam (Dutch Guiana) in 1910, and was carefully studied by Dr. KUIJPER, who published a report on it in 1912. At that time the disease was confined to nursery stock and young trees, while the older plantations seemed quite free from infection. During the past four years, however, both in Surinam and Demerara (British Guiana), the disease has spread rapidly to the older Hevea trees, and must be considered as the most serious disease of this plant in that part of the world.

Dr. GEROLD STAHEL, Mycologist to the Department of Agriculture of Surinam, has made a long and careful study of the disease. He has determined that it is caused by a fungus with three different fruiting stages, only one of which spreads the fungus. This form belongs to the genus *Scolecophium*, and its spores are produced in abundance chiefly on the under side of the very young, diseased leaves. These spores, carried by the wind, or by insects, germinate and penetrate the young tissues of the leaves very rapidly (10 hours), and thus cause widespread epidemics under suitable weather conditions. After 15 hours' drying they lose their germinating capacity.

The other two forms of the fungus occur on or around the edge of the spots on the older leaves. They appear as small, black pustules, similar in external appearance, but some contain spores of one kind, some spores of the other kind. Dr. STAHEL's work shows that these two types of spores are very slightly capable of infecting the leaves, and may be entirely disregarded as a cause of the spread of the fungus.

Dr. STAHEL states that very many rubber trees in Surinam are attacked by this disease, and that, on parts of some estates, as many as 20 % of the trees have been killed by it. According to BANCROFT the disease is widespread, virulent and epidemic in Demerara.

No successful means of fighting the disease on large trees has yet been adopted. When it attacks nursery stock or young trees in the field it may be controlled by spraying with Bordeaux mixture.

The disease occurs in several districts in Trinidad, and was more widespread in 1917 than in the preceding year. In June 1917, the author visited a number of plantations and found the trees in normal condition. Nevertheless, in one or two places where the disease was not prevalent in 1916, the trees were badly attacked; one or two old trees were killed by the re-



peated attacks, and a number of two and three year old trees died on account of the repeated defoliation.

The disease does not appear to be so virulent in Trinidad as in Surinam and Demerara, probably on account of the less favourable climatic conditions for fungous growth; nevertheless it must be considered as a later menace to the rubber industry in the island.

Spraying large rubber trees is practically out of the question on account of the expense; for this reason it is important to find and grow resistant individuals or varieties. As is now being done elsewhere, seeds should be selected in Trinidad from the trees giving the highest yields of latex, so as to use them for future plantations.

237 - **Endrot of Cranberries** (1). — SHEAR, C. L. in the *Journal of Agricultural Research*, Vol. XI, No. 2, pp. 35-42, figs. 1-3, plate A. Washington, D. C., October, 1917.

i A disease of cranberries (*Oxycoccus macrocarpus*), called "endrot" is reported. It is caused by a sphaeropsidaceous fungus which does not appear to have been described previously and which is provisionally placed in the genus *Fusicoccum* under the name of *F. putrefaciens*.

The disease has been observed in all the cranberry-growing districts of the United States (Massachusetts, Maine, New Jersey, Michigan, Wisconsin, Washington, Oregon), and of recent years has caused considerable loss of the Late Howe variety, as well as attacking other varieties (Bennet Jumbo, Cape Cod Beauty, Early Black, Early Ohio, Mathews, McFarlane Perry Pride, Prolific, Searles Jumbo, Selected Howe, Vose Pride, etc.).

The rot caused by the parasite usually starts as the blossom or stem-end of the berry, hence the common names "blossom end rot" and "stem end rot", now replaced by the simple term "endrot". The fruit attack eventually softens all over.

Only the pycnidial form of *F. putrefaciens* has been produced in culture. Dried, rotten, mummified berries, apparently destroyed by *F. putrefaciens* left exposed in the field and examined after about a year and a half, show a discomycetous fungus which is believed to be the perfect form of the parasite and which agrees very closely with *Cenangium urceolatum* Ellis.

Cultures of the mycelium show a characteristic series of colours and produce fertile pycnidia, more frequently on *Melilotus alba* than on artificial media.

Spraying experiments in Massachusetts show that this rot can be largely controlled by the use of Bordeaux mixture.

Some injury to the cranberry vines was noticed at the Massachusetts Cranberry Experiment Station at East Wareham which it was thought might be due to the use of Bordeaux mixture. The real cause of this injury which was not found in other districts, is being investigated.

238 - **Watermelon Diseases in U. S. A.** — ORTON, W. A., in U. S. Department of Agriculture, *Farmers' Bulletin* 821, pp. 18, figs. 12. Washington, D. C., May, 1917.

A brief description of the diseases of watermelons (*Citrullus vulgaris*) particularly those found in the south-east of the United States, together with the methods of control, is given.

(1) See also R. April, 1916, No. 470. (Ed.)

The most common and most serious diseases are: —

- 1) wilt (*Fusarium niveum* Erw. Sm.);
- 2) root-knot (*Heterodera radicola* [Greef] Muller);
- 3) anthracnose (*Colletotrichum lagenarium* [Pass.] Ell. and Halst.);
- 4) stem-end rot (*Diplodia* sp.).

The watermelon is also occasionally attacked by the following minor ones: —

- 1) stem blight (*Mycosphaerella citrullina* [Sm.] Gr.);
- 2) bacterial wilt (*Bacillus tracheiphilus* Erw. Sm.);
- 3) downy mildew (*Peronosplasmopara cubensis* [B. and C.] Clint.);
- 4) malnutrition, attributed to lack of potash;
- 5) blossom-end rot, probably due to defective pollination;
- 6) ground rot (*Sclerotium Rolfsii* Sacc.).

#### WEEDS AND PARASITIC FLOWERING PLANTS

— *Kennedya rubicunda*, a Leguminous Plant Injurious to Forest Trees in New South Wales. — MAIDEN, J. H., in *The Agricultural Gazette of New South Wales*, Vol. XXVIII, Pt. 10, p. 714. Sydney, October, 1917.

*Kennedya rubicunda* Vent., a native plant of Australia, very common in the coastal district of New South Wales, has recently been reported by Mr. G. F. McPHERSON, District Forester at Wyong, as being very abundant in the forests of that neighbourhood. It is found especially on gravel areas, where it attacks and covers the young hardwood trees in very short space of time. It is feared that the plant will become a danger to the forests by retarding the growth of the young trees.

— *Methods for the Control of "Wild Rice" in Italian Ricefields.* — See No. 161 of this Review.

#### INJURIOUS INSECTS AND OTHER LOWER ANIMALS.

— *Observations on Animal Pests of Cultivated Plants, Made in Sweden from 1912 to 1916.* — TULLIGREN, ALBERT, in *Meddelande No. 152 från Centralanstalten för försöksväsendet vid Jordbruksområdet, Entomologisk Avdelningen* Nr. 27, pp. 1-101. Stockholm, 1917.

Thanks to the collaboration of many correspondents the Entomological Department ("Entomologisk Avdelning") of the Central Experimentation at Stockholm is able to collect and study material from all parts of Sweden, report the presence of destructive species, and study and make known the best means of control. The correspondents, 567 in number, are distributed as follows: — Malmöhus, 31; Kristianstads, 22; Blekinge, Halland, 19; Kronoberg, 19; Jönköping, 26; Kalmar, 27; Gotland, Östergötland, 41; Skaraborg, 28; Älvsborg, 36; Göteborg and Bohus, Örebro 22; Södermanland, 48; Västmanland, 14; Upsal, 28; Stockholm, 28; Värmland, 18; Kopparberg, 22; Gävleborg, 19; Jämtland, 24; Årnerland, 16; Västerbotten, 19; Norrbotten, 10.

The publication under review gives data bearing on the period 1912-1916, during which not less than 345 animal species have been reported, distributed as follows: — orthoptera, 4; thysanoptera, 3; hemiptera, 41;

coleoptera, 85; lepidoptera, 106; diptera, 28; hymenoptera, 30; total number of insects, 297; myriapoda, 2; acarina, 19; snails, 1; nematodes, 2 birds, 14; mammals, 10.

Below are mentioned the species reported as new, or, on account of the damage they cause, deserving of special mention: —

*Gryllotalpa gryllotalpa* L. ("mullvadssyrsan") although relatively common in southern Sweden had not, for 25 years at least, caused such serious damage to crops as that reported from Skottorp (Halland) in the summer of 1916.

*Siphocoryne ligustri* Kalt. ("ligusterbladlusen") reported for the first time in Sweden towards the end of June, 1915, on privet at Svalöv (Malmöhus district).

*Rhopalosiphum lactucae* Kalt. ("nyolktistelbladlusen"), judging by the distribution of the 55 reports received at the central office, causes serious damage in the frontier provinces between Svealand and Götaland, and in Lödermanland, Nerike and Västergötland. The southern districts, on the contrary, were almost completely immune as compared with those north of the Dal river. It is interesting that the white and red currant bushes were attacked by preference, the black varieties being hardly touched.

*Agriotes lineatus* L. ("randigasädes knäpparen") has caused considerable damage to agriculture in all districts of Sweden. In Svartingsjö (Kalm.) in 1912, some acres of sugar beets were entirely destroyed; the larvae were so abundant that 34 were collected from one root alone. In Häverö sund whole fields of oats were so severely attacked that, in many districts, they had to be re-sown. Similar occurrences were reported in Ämot and Värmland. The table given below is interesting from the point of view of the different plants attacked.

Plants attacked	Number of attacks reported in:					Total number of attacks
	1912	1913	1914	1915	1916	
Oats . . . . .	64	38	44	53	30	229
Barley . . . . .	25	18	20	27	17	107
Wheat . . . . .	4	2	1	1	3	11
Rye . . . . .	3	1	2	8	3	17
Beet . . . . .	9	7	5	2	4	27
Potato . . . . .	6	8	7	3	5	29
Cabbage . . . . .	4	1	2	3	5	15
Turnip . . . . .	5	4	—	2	3	14
Carrot . . . . .	—	1	—	2	2	5
Onion . . . . .	1	—	—	—	2	3
Viper's grass . . . . .	—	—	—	—	1	1
Cucumber . . . . .	3	—	—	1	—	4
Salad . . . . .	2	2	—	1	—	5
Garden Strawberry . . . . .	—	—	1	—	—	1
Parsnip . . . . .	—	2	—	—	—	2
Asparagus . . . . .	1	—	—	—	—	1

Oats and barley were, therefore, most frequently attacked; cabbage, turnip, potato, beet, wheat and rye are also subject to attacks from *Agriotes*; but less frequently; the other plants may be considered as rare hosts.

*Apamea testacea* Kb. ("gässrotflyet"), reported for the first time in Sweden at Svalöf on Gramineae in 1915.

*Dasyfolia templi* Thubg. ("fjäderborst flyet"), very rare in Sweden; in July, 1916, the larvae of this lepidopteron caused great damage to *Changelica officinalis*, cultivated as a medicinal plant at Dals-Rostock.

*Callimorpha dominula* L. ("glansspinnaren"): the larvae of this lepidopteron, very rare in Scandinavia, caused great injury in the spring of 1914 to young elm and ash trees near Ovesholm (Kristianstad).

*Enarmonia prunivora* Wlsh. (?) ("mindre äpplevecklaren") was noted for the first time near Repelycke, Rännmön, in November, 1915, on apples, and, on frequent occasions, in other localities. The Station has not been able to identify with certainty this insect, which, instead of being identical with the American *E. prunivora*, might form a native variety.

The birds reported as harmful during the period 1912-1916 were:

*Corvus cornix* L. ("kråkan"); *C. frugilegus* L. (råkan); *C. monedula* ("kajan"); *Pica pica* L. ("skatan"); *Sturnus vulgaris* L. ("staren"); *Casser domesticus* L. ("gråsparven"); *Fringilla montifringilla* L. ("bergsten"); *F. coelebs* L. ("bofinken"); *Loxia curvirostra* L. ("mindre korsbotten"); *Pyrrhula pyrrhula* L. ("domherren"); *Turdus pilaris* L. ("snösånan"); *T. merula* L. ("koltrosten"); *Larus canus* L. ("fiskmåsen"); *rao nigallus* L. ("tjädern").

Among the mammals reported as causing damage were: —

*Erinaceus europaeus* L. ("sgelkotten"); *Talpa europaea* L. ("mullvaren"); *Sciurus vulgaris* L. ("ekörren") which destroys pears, apples and elm nuts; *Microtus agrestis* L. ("akersorken"); *Arvicola terrestris* L. ("ättensorken"); *Lemmus lemmus* L. ("fjällemmeln"); *Lepus timidus* L. ("L. europaeus" which gnaws the bark of fruit trees; *Alces alces* L. and *brodus capreolus* L., injurious to forest trees.

The attacks were frequent and serious, particularly in 1912-14, when summers were very hot and dry; slight and less frequent in 1915 and 1916, rather wet and cold years.

The following particulars are worthy of note: —

**CEREALS.** — These suffered particularly from larvae of *Melolontha* ("allonborren") and *Agriotes lineatus* L. throughout Sweden, but particularly in the southern districts, where, in 1912 and 1913, *Contarinia tritici* Kirby ("vetemyggan") was also found in abundance in the barley and at fields. More or less serious damage was done by *Siphonella* (*Chlorophila*) *pumilionis* Bjerk. ("kornflugan"); *Oscinella* (*Oscinis*) *tritici* L. ("frit-an"); *Hylemyia coarctata* Fall. ("rågbröddflugan"); and larvae of *Oestis segetum* Schiff. ("sädesbröddflyet").

**FODDER GRAMINEAE.** — *Amaurosomus* (*Cleogastera*) *armillatum* Zett. and *flavipes* Fall., which lower the yield in seed of *Phleum* by 25 %.

**CLOVER.** — *Apion apricans* Herbst. ("Kloverspettväveln") for the clover and a nematode, *Tylenchus devastatrix* Kuhn., for the hay.

CABBAGE and TURNIP. — *Phyllotreta* sp. ("jordlopporna"); *Plutella maculipennis* Curt. ("kålmalen"); *Eurydema oleracea* L. ("rapssugaren"); *Lygus pratensis* L. ("angsstinkflyet") in Norrland; and *Chorthippa* (*Phibia*) *brassicae* Bouché ("kålflugan").

CARROT. — *Trioxa viridula* Zett. ("morotbladloppan") and *Pedraza rosae* L. ("morotflugan").

BEE. — *Blithophaga* (*Oiceoptoma*) *opaca* L. ("gulhåriga skinnarbagga").

LEGUMINOSAE. — *Physopus robusta* Uzel ("vanliga arttripsen"); *Sitona lineata* L. ("årtviveln") and *Grapholium nigricana* Stph. ("årtvivellaren").

FRUIT TREES — *Psylla mali* Schmbg ("applebladloppan"); *Psylla* sp. ("pårönbladloppor"); *Aphis pomi* D. G. ("äpplebladlusen"), especially in the very hot summer of 1914; *Anisandrus* (*Xyleborus*, *Scolytus*, *Tomicus*) *dispar* F. ("lövvedborren"); *Phyllobius* sp. ("lövvivlar") in 1912; *Anthonomus pomorum* L. ("äppleblomviveln") in 1913-1914; *Cheimatobia brumata* L. ("frostfjäriln"); *Argyresthia conjugella* Zell. ("rönnbårsmalen") in 1916; *Malacosoma neustria* L. ("ringspinnaren").

Besides the lepidoptera already mentioned there were: *Argyrotaenia* (*Olethreutes*) *variagana* Hb. ("vanliga knoppvecklaren"); *Tmetocera calana* F. ("mindre k"); *Carpocapsa pomonella* L. ("äpplevecklaren"), very common; *Hyponomeuta malinellus* Zell. ("äpplespinnmalen"); and *Lyonezia clerella* L. ("clerksminerarmal").

The pear trees suffered very severely from *Contarinia pyraeora* K. ("påröngallmyggan"); plum trees from *Hoplocampa minuta* Chies. ("plommönstekeln"), which reduced the crop by 20 to 80 % (as at Kivik, Fjälkestad); both species were very abundant in 1912 and 1913 throughout southern Swden.

BERRIES — *Pterodinea* (*Pteronius*) *ribesii* Scop. ("storakrusbårsstekeln") and *Pristiphora appendiculata* Lep. ("lilla K."), on gooseberry; *Rhopalosiphum lactucae* Kalt. ("mjölkstiselbladlusen") on red currant (1913); *Anthonomus rubi* Hbst. ("hallonviveln") on strawberries and raspberries.

FOREST TREES. — *Cheimatobia boreata* Ln. ("björk frostmätaren") and *Coleophora fuscedinella* Zelh. ("björk sackdrogarmalen"), very plentiful, especially in 1912; *Myelophilus piniperda* L. ("svarta margborea") and *M. minor* ("mindre m."); *Dendroctonus micans* Kug. ("fättebjörkborren") and numerous species of the genera *Ips* and *Pityogenes*.

#### 242 — Scale Insects (*Coccidae*) from Asia, Africa, America and Oceania.

NEWSTEAD, ROBERT, in the Bulletin of Entomological Research, Vol. VIII, Pt. 2, pp. 1-25. London, December, 1917.

The following species are enumerated:

- 1) *Aspidoproctus armatus* Newst., on a tree of unknown species. Salvador (Portuguese Congo);
- 2) *A. glaber* Lind., on the tree locally known as "niwanga", Mt. (Nyasaland);

(1) See R. Oct., 1917, No. 977 and No. 244-244 of this Review. (Ed.)

- 3) *A. pertinax* Newst., on a tree known as "kalati" in the preceding locality; the same scale seems to have been observed on a wild plant at Bangalore, Lal Bagh (South India);
- 4) *A. tricornis* Newst., on the "mwanga" tree, Mlanje;
- 5) *Icerya aegyptiacum* Dougl., on young date palm, Zanzibar; this is the first record of this scale at Zanzibar;
- 6) *I. maxima* Newst., on tree trunk Ngamba Is., Lake Victoria (Uganda);
- 7) *I. seychellarum* Westw., on mango, Entebbe (Uganda);
- 8) *I. sulfurea* Lind., on *Eranthemum* in the preceding locality, and doubtfully on *Castilloa* at Kampala (Uganda);
- 9) *Stictococcus formicarius* Newst., on *Ficus* sp., Entebbe;
- 10) *St. multispinosus* Newst., on *Cola acuminata*, Aburi (Gold Coast); small percentage of the females were attacked by chalcidid parasites;
- 11) *Markhamia platycalyx*, Kampala (Uganda);
- 12) *Sy. sjöstedtii* Ckll., on cacao, Aburi;
- 13) *Pseudococcus citri* Risso, at Nairobi, Old Government Farm British East Africa; on coffee, at Entebbe; on an unknown shrub, Tero Forest (Uganda);
- 14) *Ps. sacchari* Ckll., on rice, at Megapatan (Madras Pres.); on sugar cane at Georgetown (British Guiana);
- 15) *Ps. hymenocleae* Ckll., host plant not stated, at Onderstepoort, Transvaal (South Africa);
- 16) *Ps. virgatus* Ckll., on coffee, Nama Konkoni, Chagwe (Uganda); on cassava and sugar cane, Zanzibar; on French beans, *Jatropha Curcas* and *Colocasia*, Aburi (Gold Coast); on oleander and a creeper called "Samica", Accra (Gold Coast); on cacao seedlings, Ibadan (Southern Nigeria);
- 17) *Phenacoccus insolitus* Green, on egg-plant, Saidapet (Madras);
- 18) *Tachardia decorolla* Mask., on *Anona muricata*, badly infested, Entebbe; Pretoria (South Africa);
- 19) *Asterolecanium coffeae* Newst., on coffee plants in British East Africa and in Uganda (Nakasanje, Chagwe; Banda); heavy infection; small percentage of the specimens were infected by chalcidid parasites;
- 20) *A. bambusae* Bdv., on bamboo, at Aburi (Gold Coast) and at Entebbe (Uganda); also found in South Africa;
- 21) *Cerococcus hibisci* Green, on egg-plant, Guntur (S. India);
- 22) *Ceroplastodes cajuputi* Mask., on red gram, *Zizyphus*, *Ocimum sanctum*, Coimbatore; on wild indigo, Anantapur Dist. (S. India);
- 23) *Inglisia chelonoides* Green, on *Parkinsonia aculeata*, Coimbatore;
- 24) *I. conchiformis* Newst., on *Gliricidia maculata*, Aburi;
- 25) *Ceroplastes actiniformis* Green, on coconut, Coimbatore;
- 26) *C. africanus* Green, in South Africa; on acacia, N. E. of Lake George (Uganda);
- 27) *C. ceriferus* Anderson, on wild elm, Coimbatore;
- 28) *C. cirripediformis* Comst., on *Hura crepitans* in association

with *Lecanium* (*Akermes*) sp., Berbice (British Guiana); on *Ipomoea* sp. Georgetown;

28) *C. denudatus* Ckll., on a wild Solanaceae, Demerara (British Guiana);

29) *C. ficus* Newst., on *Ochra pulchella*, Wonderboom (South Africa); on *Anona*, Aburi;

30) *C. personatus* Newst., on *Coffea liberica*, Aburi;

31) *C. quadrilineatus* Newst., Kimi Is., Lake Victoria (Uganda);

32) *C. rubens* Mask., on mango, Canyon District, Chicacola (S. India); on young orange trees, Maruhubi, Zanzibar;

33) *C. ugandae* Newst., on an unknown tree, Mount Mubendi (Uganda);

34) *C. vinsonioides* Newst., on coffee, Mabira Forest (Uganda);

35) *Pulvinaria burkilli* Green, on *Zizyphus* sp., Coimbatore;

36) *P. cupaniae* Ckll., on *Ficus* sp., badly infested; on mulberry imported from U. S. A., Jamaica;

37) *P. jacksoni* Newst., on *Eranthemum bicolor*, Kampala (Uganda); on granadilla, Nairobi (British East Africa);

38) *P. psidii* Mask., on coffee badly infested, Mabira (Uganda) on the same plant at Mpumi, Chagwe (Uganda); on coffee at Kikuya (British East Africa) and on "nsambyia" at Bukoba (British East Africa); on mango, Coimbatore; on guava, Koilpata (S. India);

39) *Lecanium* (*Saissetia*) *cuneiformis* Green, on *Acockeranthra* sp., Mua Hills (Brit. E. Africa);

40) *L. (S.) hemisphaericum* Targ., at Limosa (Brit. E. Africa); on *Aristolochia*, Nagunga; on *Adiantum*, Entebbe; on coffee, Mabira (Uganda);

41) *L. (Coccus) hesperidum* L., on banana, near Mombasa; on lemon; Mua Hills (Brit. E. Africa);

42) *L. (S.) nigrum* Nietn., on *Lawsonia alba* and on cotton, heavily infested, Coimbatore; on coffee, Mwera (Uganda); on ornamental shrub Government Farm, Kabete (Brit. E. Africa);

43) *L. (Eulecanium) somereni* Newst., on *Erythrina excelsa*, Nagung (Uganda); specimen heavily parasitised;

44) *L. (Eucalymnatus) tessellatus* Sign., on Malacca apple associated with *L. wardi*, Botanic Gardens, Georgetown (British Guiana);

45) *L. (Coccus) viridis* Green, on Liberian coffee, Onderneeming, Essiquibo (Brit. Guiana); also observed in S. Africa;

46) *Hemilecanium imbricans* Green, on *Cedrela Toona*, heavily infested, Southern Mysore (S. India);

47) *Aspidiotus* (*Chrysomphalus*) *aurantii* Mask., on orange tree, Kabete (British E. Africa); on Mount Chirinda, Melsetter (Southern Rhodesia) the insect was heavily infested by *Nectria* (?) sp.; chalcidid parasites were also present; a few specimens on *Acacia* in association with *Chionaspis capensis* Newst., at Pretoria (S. Africa); on citrus imported from India in 1913, in Jamaica; on bananas, Taveuria (Fiji);

48) *A. camelliae* Sign., on apple and rose tree, Nairobi; on trunk of black wattle, on apple and fig, Kabete (Brit. E. Africa);

- 49) *A. cyanophylli* Sign., on peach, Entebbe (Uganda); on banana,avenuria (Fiji);
- 50) *A. cydomiae* Comst., on mango, Kabete, on Bauhinia, guava, rose brubs, Entebbe; on Cape lilac, Kampala (Uganda); on oleander, Accra old Coast); on *Nectandra coriacea*, Jamaica; on fig fruit and on vine, imbatore; on pear, Bangalore (S. India);
- 51) *A. destructor* Mask., on coconut leaves, heavily infested, but about % destroyed by a small coleopterous larva, Cochin State, Kimbalengua India); on mango in association with *Lecanium adersi* Newst., and on ms of castor oil plant, Marahubi (Zanzibar); on an unnamed plant, S. rica; on coconut palm, Mombasa (Brit. E. Africa); on banana, Kisube; mango, guava, screw-pine and Ceara rubber, Entebbe; on banana and cea *brasiliensis*, Kampala (Uganda); on mango, Accra and on *Pandanus*, nuri (Gold Coast);
- 52) *A. (Chrysomphalus) dictyospermi* Morgan, at Fort Beaufort (S. rica);
- 53) *A. (Chrys.) ficus* (Riley) Comst., on mango, Coimbatore; on *Ficus* , Pemkonda (S. India);
- 54) *A. (Pseudaonidia) fossor* Newst., on grape vine, Georgetown (Brit. iana);
- 55) *A. orientalis* Newst., in Brit. E. Africa, on tamarind fruit, very avily infested, at Coimbatore; on egg-fruit, heavily infested, Guntur . India);
- 56) *A. (Chrys.) rossi* Mask., on *Eucalyptus* sp., Modderfontein (S. rica);
- 57) *A. (Pseudaonidia) tesseraus* d'Emm., on *Matayba apetala*, ndandra coriacea, *Trophis racemosa*, all heavily infested, Jamaica;
- 58) *A. (Ps.) trilobitiformis* Green, in Coimbatore (S. India); on oleander d mango, Kampala (Uganda);
- 59) *A. (Chrys.) triglandulosus* Green, attached to scabs on Jack leaf, ugalore (S. India);
- 60) *A. (Selenaspidus) silvaticus* Lind., on orange tree, Entebbe ganda); 50 % of the females were attacked by a parasitic fungus;
- 61) *A. (S.) articulatus* Morgan, on citrus imported from India, King- on, Jamaica;
- 62) *Chionaspis (Hemichionaspis) minor* Mask., host plant not stat- (cotton?), Ibadan (S. Nigeria), on *Jatropha Curcas*, Aburi (Gold Coast); willow trees, Drakensburg, Cape Province (S. Africa);
- 63) *Ch. dentilobis* Newst., on unnamed plant, Eutebbe; a large per- tage of the females were parasitised by chalcid hymenoptera;
- 64) *Ch. (Phenacaspis) lutea* Newst., on *Funtumia*, Aburi (Gold Coast);
- 65) *Fiorinia proboscidea* Green, on citrus imported from India. ngston, Jamaica;
- 66) *Parlatoria pergandei* Comst., on the same plant in the same lo- lity;
- 67) *P. zizyphus* Lucas, as the two preceding cases;



- 68) *Ischnaspis filiformis* Doug. on *Ficus* sp. in Jamaica, on coffee, Mabira Forest, Chagwe (Uganda);  
 69) *Mytilaspis* (*Lepidosaphes*) *citricola* Pack., on sickly lime-tree, Accra (Gold Coast);  
 70) *Lepidosaphes gloverii* Pack., on croton, Entebbe (Uganda).

243 - A List of Uganda Coccidae, their Food-Plants and Natural Enemies (1).  
 GOWDEY, C. C., in *Bulletin of Entomological Research*, Vol. VIII, Pt. 2, pp. 187-189, 1917;  
 December, 1917.

The list includes:

- 1) *Monophlebus raddeoni* Westw., food plant unknown;
- 2) *Icerya caudata* Newst., on crotons (*Codiaeum*);
- 3) *I. nigroarcolata* Newst., on coffee and crotons;
- 4) *I. seychellarum* Westw., on *Monodora Myristica*, *Eranthemum bicolor* and mangi;
- 5) *I. sulphurea* Lind., on *Castilleja* rubber (*Castilleja*) and guava (*Psidium Guajay*);
- 6) *Asterolecanium bambusae* Bdv., on bamboo;
- 7) *A. coffeae*, Newst. on coffee;
- 8) *Pseudococcus bromeliae* Bouché, on pine apple;
- 9) *Ps. citri* Risso, on coffee (leaves, stems and roots), orange, lemon and cacao; root form is accompanied by an ant *Acropyga gowdeyi* Wheeler;
- 10) *Ps. virgatus* Kell., on coffee;
- 11) *Tachardia decorella* Mask., on *Anona muricata* and guava; parasitised by *Acromyza africa* Gir. and *Coccophagus nigropleurum* Gir., and preyed on by caterpillars of *Stalpersia oestletis* Meyr.;
- 12) *T. longistola* Newst., on guava, *Ficus Thonningii*, and *Anona muricata*;
- 13) *Pulvinaria jacksoni* Newst., on cotton; parasitised by *Tetrastichus gowdeyi* Gir.;
- 14) *Pulv. psidii* Mask., on coffee, *Funtumia elastica*, guava, tea, *Alternanthera versicolor* and *Dolichandrone platycaulyx*;
- 15) *Pulv. subterranea* Newst., on roots of *Chrysanthemum*;
- 16) *Ceroplastes africanus* Green, on *Cajanus indicus* and *Acacia* sp.;
- 17) *C. ceriferus* And., on coffee, *Antigonon leptopus*, orange, *Funtumia latifolia* (or *Hibiscus*), Agave, croton, *Anona muricata*, tea and *Ficus Thonningii*;
- 18) *C. conformis* Newst., on *Ficus* sp. and *Hura crepitans*;
- 19) *C. destructor* Newst., on guava;
- 20) *C. fleus* Newst., on *F. Thonningii*;
- 21) *C. galeatus* Newst., on coffee and *F. Thonningii*; parasitised by *Neomphalodes ceroplastae* Gir., *Eurytoma galeati* Gir. and *Scutellista cyanea* Motsch.;
- 22) *C. quadrifasciatus* Newst., on *Anona muricata* and *Dolichandrone platycaulyx*;
- 23) *C. singularis* Newst., on guava;
- 24) *C. subdenudatus* Newst., on an undetermined plant;
- 25) *C. ugandae* Newst., on *Anona muricata* and *Acacia* sp.;
- 26) *C. vinsonioides* Newst., on *Baobab Eminii*, coffee, guava and *Cajanus indicus*;
- 27) *Inglisia castilloae* var. *theobromae* Newst., on cacao;
- 28) *I. conchiformis* Newst., on *Hibiscus*, *A. muricata*, *Acalypha*, *Haronga madoi*, *riensis* and guava; preyed on by *Eublemma scitula* Ramb.;
- 29) *Ceroplastodes gowdeyi* Newst., on *F. Thonningii*;
- 30) *Coccus africanus* Newst., on coffee;

(1) See also *B. Nov.-Dec.*, 1911, No. 3257; *B. Aug.*, 1913, No. 1010; *B. March*, No. 293; *R. Oct.*, 1917, No. 977. (Ed.)

- 37) *C. discorepans* Green, on tea roots;
- 38) *C. elongatus* Sign. on *Albizia* sp. and *Cajanus indicus*;
- 39) *C. hesperidum* L., on orange;
- 40) *C. stiger* Newst., on guava;
- 41) *C. longulus* Dougl., on *Gliricidia maculata*;
- 42) *C. signatus* Newst., on guava;
- 43) *C. tenuivalvatus* Newst., on *Pennisetum purpureum* and *Cymbopogon citratus*;
- 44) *C. viridis* Green, on coffee and guava;
- 45) *Eulecanium filamentosum* Newst., on an undetermined plant;
- 46) *E. somereni* Newst., on mulberry (*Morus*), *Tecoma stans* et *Dolichandrone platycalyx*;
- 47) *Saissetia hemisphaerica* Targ., on ferns and coffee;
- 48) *S. nigra* Nietn., on coffee, *Ficus* sp. and *A. muricata*;
- 49) *S. oleae* Bern., on *Chlorophora excelsa*; parasitised by *Coccophagus saintebeckei* Gir.;
- 50) *S. subhemisphaerica* Newst., on coffee;
- 51) *Stictococcus coccineus* Newst., on *Acacia* sp. with *Ceroplastes subnudatus* Newst.;
- 52) *S. diversiseta* Silv., on *Hybiscus*, *Cajanus indicus*, cacao, *Croton Tiglium*, *A. mu-*  
*da*, mulberry, *Artocarpus integrifolia* and *Dolichandrone platycalyx*; preyed on by *Eublemma*  
*maculata* Salm.;
- 53) *S. formicarius* Newst., on *Ficus* sp.;
- 54) *S. gowdeyi* Newst., on coffee and *Haronga madagascariensis*; parasitised by *Cocco-*  
*peris* Gir. and *Epitetrastichus uandensis* Gir.;
- 55) *S. multispinosus* Newst., on *Dolichandrone platycalyx*;
- 56) *Chionaspis cassiae* Newst., on *Cassia floribunda*;
- 57) *C. dentilobis* Newst., on palms and *Sapium mannianum*;
- 58) *C. funtuniae* Newst., on *Funtunia latifolia*;
- 59) *C. substriata* Newst., on palms;
- 60) *Diaspis boisduvali* Sign., on *Baikiaca insin*is;
- 61) *D. regularis* Newst., on *Chlorophora excelsa*;
- 62) *Aulacaspis chionaspis* Green, on *S. mannianum*, *Erythrina excelsa* and *Cassia flori-*  
*da*;
- 63) *Hemichionaspis chionaspiformis* Newst., on an undetermined plant;
- 64) *Aspidiotus cyanophylli* Sign., on guava, palms and bananas;
- 65) *A. cydoniae* Comst., on guava;
- 66) *A. destructor* Sign., on banana, *Pandanus* sp., guava and mango; preyed on by  
*hacua pumilipennis* Muls.;
- 67) *A. goadeyi* Newst., on *Anona muricata*;
- 68) *A. lalaniae* Sign., on palms;
- 69) *A. transparens* Green, on tea;
- 70) *Pseudonidia baikiacae* Newst., on *Baikiaca* sp.;
- 71) *Ps. trilobitiformis* Green, on oleander and mango;
- 72) *Selenaspidus articulatus* Morg., on coffee and *F. Thonningii*;
- 73) *S. silvaticus* Lind., on orange;
- 74) *Chrysomphalus dictyospermi* Morg., on palms, mango and rose;
- 75) *Lepidosaphes bectii* Newm. (= *L. citricola* Pack.), on *Citrus* spp.;
- 76) *L. gloveri* Pack., on *Citrus* and crotoms;
- 77) *Ischnaspis longirostris* on palms, bamboo and coffee;
- 78) *Gymnaspid aircanae* Newst., on an undetermined plant.

244 - The Status of Introduced Coccids in South Africa in 1917 (1). — THOMAS, K. and KELLEY, ALBERT F., in *Bulletin of Agricultural Research*, Vol. VIII, Pt. 2, pp. 181-185, London, December, 1917.

The following list, compiled from data obtained up till August, 1917, during the inspection of the local nurseries, gives the species introduced and established in South Africa. Species, such as *Lecanium bituberculatum* Targ., *L. corni* Bouché, *Pulvinaria betulæ* (L.) Sign., *Diaspis rosæ* (Bouché), *Aspidiotus piri* Licht. and *A. ostraciformis* Curt., which having been stopped at the ports of entry, could not establish themselves in the country are not included.

The coccids enumerated are : —

- 1) *Icerya purchasi* Mask., generally distributed throughout the Union but satisfactorily controlled by *Novius cardinalis*;
- 2) *I. seychellarum* Westw., Durban (Johannesburg, ex. Durban);
- 3) *Orthezia insignis* Dougl., Cape Peninsula, Port Elizabeth, East London and Natal Coast. Sporadic in Natal midlands;
- 4) *Pseudococcus adonidum* (L.) Westw., Cape Town, Port Elizabeth, Durban, Pietermaritzburg, Pretoria and Johannesburg. Chiefly a plant pest;
- 5) *Ps. aurilanus* (Mask.), Cape Town, Graaff Reinet, Durban, Pietermaritzburg, Richmond, Johannesburg and Pretoria;
- 6) *Ps. bromeliæ* (Bouché), eastern Cape Province and Natal Coast;
- 7) *Ps. citri* Russo, prevalent in the Cape Peninsula, but generally confined to nurseries, where it appears to be Dr. MARCHAL's variety *Ps. citi* var. *colorum*, as *Coleus* is chiefly attacked by it. In the same district it is very rarely found on citrus, being replaced by *Ps. fragilis* Brain; the most common species in vineyards and gardens is *Ps. capensis* Brain; similar conditions exist in Natal, but the citrus species here is *Ps. filamentosus* Ckll., while the most common species in gardens in Durban is *Ps. virgatus* Ckll.; in Pretoria *Ps. citri* is occasionally extremely abundant on orange but, from the majority of citrus orchards, such as those of Rustenburg, the species is apparently absent; the most common species in gardens in Pretoria is *Ps. burnerae* Brain;
- 8) *Ps. filamentosus* Ckll., Bathurst, Richmond, Pietermaritzburg (Citrus), Pretoria (*Grevillea*);
- 9) *Ps. nipæ* Mask, Cape Town, Graaff Reinet, Port Elizabeth, East London, Durban, Pietermaritzburg, Johannesburg and Pretoria; found only on palms in greenhouses, except at Durban, where it is occasionally found out of doors;
- 10) *Ps. sacchari* Ckll., Zululand, Natal Coast and Tzaneen (Transvaal);
- 11) *Ps. virgatus* Ckll., Durban, Pietermaritzburg and Pretoria (Durban);
- 12) *Tylococcus insolitus* (Green), East London, King Williamstown and Pietermaritzburg;

(1) See also No. 242 of this Review (H.L.)

13) *Eriococcus araucariae* Mask., common in the Cape and Natal, and occasionally found in Johannesburg and Pretoria ;

14) *Asterolecanium bambusae*, Bdv., Natal coast and midlands ;

15) *A. variolosum* (Ratz.), Cape Peninsula, Elsenburg, Grabouw, Simondium, Irene, Johannesburg, Krugersdorp, Newclare and Canada Junction ;

16) *Cerococcus ornatus* Green, found on one occasion only on stems *Doryalis caffra* and *Calodendrum capensis* at Pietermaritzburg ;

17) *Coccus cacti* Goeze, in the Botanic Gardens, Cape Town, where was introduced many years ago ;

18) *C. confusus capensis* Green, may usually be found where *Opuntia monacantha* is abundant, e. g. in the Cape Peninsula, Albany and surrounding districts, and occasionally in the Orange Free State ;

19) *C. indicus* Green, introduced in 1913 by the Queensland Prickly Pear Commission to destroy *Opuntia monacantha* ; it is now well established in the Cape Peninsula, Komgha, Natal and Pretoria, and was recently received from Mtunzini (Zululand) ;

20) *Lecanium hesperidum* L., widely distributed and common ;

21) *L. elongatum* Sign., Johannesburg and Pretoria ;

22) *Saissetia hemisphaerica* (Targ.), Cape Town, Grahamstown, Durban, Pietermaritzburg, Pretoria and Johannesburg (pot plants) ;

23) *S. nigra* Nietn. (*S. nigrella* King), Bayville, C. P. and Natal (on *Ficus* spp. only) ;

24) *S. oleae* Bern., Cape Peninsula, Ceres, Port Elizabeth, Queenstown, Stellenbosch, Uitenhage, Fort Beaufort, Durban, Pietermaritzburg and Pretoria ;

25) *Protopulvinaria pyriformis* Ckll., Durban, Pietermaritzburg (Durban) ;

26) *Aspidiotus destructor* Sign., Durban and Inchanga (uncommon) ;

27) *Aspidiotus fimbriatus* var. *capensis* Newst., Port Elizabeth (on as only) ;

28) *A. (Diaspidiotus) forbesi* Johns., Cradock, Pietermaritzburg, chiefstroom and Bethlehem ;

29) *A. hederæ* (Vall.) Sign., widely distributed throughout the Union common ;

30) *A. (Hemiberlesea) lataniae* Sign., generally distributed ;

31) *A. (Hemiberl.) rapax* Const., Johannesburg, Louis Trichardt Pretoria ;

32) *A. (Diaspidiotus) perniciosus* Const., in most centres an attempt been made to eradicate this insect as soon as discovered ; it has been tried from : — Estcourt, Frere, Hilton Road, Ladysmith, Moorleigh, seastle, Pietermaritzburg, Utrecht, Vryheid, Weenen, Winterton, Dundee and Richmond, in Natal ; Amersfoort, Benoni, Bethal, Boksburg, kop, Bronkhorstspuit, Cullinan, Heidelberg, Johannesburg, Middelburg, Nylstroom, Pretoria, Rayton, Scheerpoort, Standerton and Witk, in the Transvaal ; Kroonstad and Viljoen's Drift, in the Orange Free te ;

- 33) *A. transparentes* Green, Natal Coast ;
- 34) *A. (Selenaspidus) articulatus* Morgan, Durban and Pietermaritzburg ; an uncommon scale ; the most common species of *Selenaspidus* is *S. silvaticus* Ldgr. ;
- 35) *Chrysomphalus aurantii* Mask., widely distributed throughout the Union ;
- 36) *Chrys. dictyospermi* Morgan, Cape Town, East London, Kimberley, Kingwilliamstown, Durban, Pietermaritzburg, Barberton, Johannesburg, Nelspruit and Pretoria ; this species is common only in greenhouses, and though it has been found on rose and peach, it has not yet been recorded on citrus in the Union ;
- 37) *Chrys. ficus* Ashmead, common in orchards on the Natal Coast and in a few districts in the Transvaal (Warmbaths, Rustenburg and Nelspruit) ; a greenhouse pest along the Cape and Natal Coasts, and also at Queenstown, Pietermaritzburg, Johannesburg and Pretoria ;
- 38) *Chrys. rossi* Mask., Cape Town (reported but not well established here), East London, Grahamstown, Queenstown (as for Cape Town), Eastcourt, Dundee, Durban, Pietermaritzburg, Johannesburg, Pretoria, Krugersdorp, Pietersburg, Bloemfontein ;
- 38<sup>a</sup>) *Chrys. rossi* var. *greeni* n. var., East London and Durban on native trees (uncommon) ;
- 39) *Morganella maskelli* (Ckll.), established at Durban on a number of different host plants ; reported from Pietermaritzburg ; on citrus : Hillary ;
- 40) *Diaspis boisduvali* Sign., Durban, Pietermaritzburg and Pretoria (uncommon) ;
- 41) *D. bromeliae* (Kern), Natal Coast, Kingwilliamstown and Pretoria ; uncommon, chiefly in greenhouses ;
- 42) *D. echinocacti* (Bouché), Graaff Reinet and Pearston, C. P. and other places in the Karroo ;
- 43) *D. (Aulacapsis) pentagona* Targ., common in the Western Province of the Cape and in most of the other large towns in the Union ;
- 44) *Pseudaonidia trilobitiformis* Green ; Hillary (Durban) on *Litchi* (*Nephelium Lit-chi*) (probably ex Mauritius) ;
- 45) *Parlatoria pergandei* Comst., Cape Town, Grahamstown, Port Elizabeth, Durban, Johannesburg and Pretoria (in greenhouses) ;
- 46) *P. proteus* Curt., Durban (in greenhouses, uncommon) ;
- 47) *P. zizyphi* Lucas, in several orchards near Durban ; not common ;
- 48) *Chionaspis simplex* Green, var., Durban (on bamboo) ;
- 49) *Pinnaspis aspidistrae* Sign., common in greenhouses ;
- 50) *Fiorinia fiorinae* Targ., Cape Town, Graaff Reinet, Grahamstown, Port Elizabeth, Uitenhage, Durban, Hillary, Inghanga, Johannesburg (ex coast) ; in greenhouses ;
- 51) *Howardia biclavis* Comst., Durban ;
- 52) *H. moorsi* Doane and Ferris, Durban Botanic Gardens ;
- 53) *Lepidosaphes pinniformis* Bouché, Cape Peninsula, Port Elizabeth, Uitenhage, Stellenbosch, Somerset West, Bathurst, East London

district, Natal Coast, Cape Town, Greytown, Piet Retief, Pietermaritzburg, Barberton, Nelspruit (in citrus orchards); Cape Town, Durban, Pietermaritzburg, Uitenhage, Johannesburg (in greenhouses, chiefly on croton [*Codiaeum*] and *Murraya*);

34) *L. gloveri* Packard, Port St. Johns and in four orchards of the Cape Peninsula, Stanger and Warmbaths;

35) *Ischnaspis longirostris* Sign., East London, Port Elizabeth, Durban, Hillary (Pretoria and Johannesburg, probably ex Durban), occurs on a number of ornamental plants; at Warmbaths on citrus.

45 - **The Fluted Scale (*Icerya purchasi*)**. -- SPEYER, F. R., in *Department of Agriculture, Ceylon, Leaflet No. 3*. Colombo, Ceylon, March, 1917.

So far as is known India is still free from attacks of this dreaded insect. The island of Ceylon was also considered to be immune till, in December, 1915, the insect was discovered on *Acacia decurrens* on an estate in the Agra-patnas (Central Province). It was, immediately after, reported from another estate in the same district, again on *A. decurrens*, and was found at Paradeniya on numerous specimens of *Casuarina*, one of which was seriously attacked. In August, 1916, an *Acacia* forest in Ambawela was attacked by large numbers, which, in October, were exceeded on the estates in the Agra-patnas. The insect was also found on *A. dealbata*. It was next noticed that acacia plants served as hosts to the scale in the districts of Galaha and Upper Hewabeta, and two females were found on a citrus in the first of these districts. Reports from Kandy show that, though other plants may be attacked, acacia is the centre of infection.

Apart from the damage which may be done to fruit trees and the temporary weakening of the acacias, as a result of the holes made by the insect, there are other plants in the island which it is important to protect from its attacks.

Although controlled by a fungus, *Cephalosporium*, during the north-east monsoon in the districts of Ambawela, Hewabeta and Galaha, and, it seems, before this monsoon in the Agra-patnas, the insect increases very greatly during the other periods. There are native lady-birds which feed on the scale at Paradeniya and at Ambawela, but, at present, they are few in number. The chances of its spontaneous natural extermination are small, and for some time yet an increase is to be expected.

To control the pest before it touches economic products, a full knowledge of its distribution is urgently required. It may still be sufficiently localised for radical extermination to be possible. If it be more widely distributed, radical extermination might be used in the worst centres, while lady-birds imported from South Africa or Australia could be distributed to all outlying localities with a view, at least, of keeping the scale within bounds.

6 - **Observations on *Lepidiota frenchi* Black. A Sugar Cane Pest in Queensland** (1). -- JARVIS, EDMUND, in *Queensland Bureau of Sugar Experiment Stations, Division of Entomology, Bulletin No. 5*, pp. 1-11, 1 pl. Brisbane, 1917.

Although rather less injurious to sugar cane than the grey-back ckechafer (*Lepidiota albohirta* Water) (2), *L. frenchi* Black may, from an

(1) See also *B.* August, 1915, No. 874; *R.* Sept., 1916, No. 1048. -- (2) See also *R.* Dec., 1916, No. 1343. (Ed.)

economic point of view, be considered as holding second place among the Scarabaeidae which attack this crop in northern Queensland.

The coleopterous, which normally lives at the expense of the root system of the native cereals and other herbaceous plants, shows a marked preference for sugar cane. An invasion of the insect, the importance of which is worthy of note, was reported at Meringa (District of Cairns) in April, 1917. While ploughing red volcanic soil there were collected from the chains of furrow, within a few hours only, 186 larvae of the second stage representing 2 418 larvae per acre, i. e. an average of 0.85 per stool of cane.

Considering the affinity between *L. franchi* and *L. albohirta*, the excessive abundance of the insect in question, its varied diet, its frequent appearance in sugar cane plantations and its preference for this plant, the author has collected in his paper the observations made up to the present on the life cycle of the insect and its habits.

247 - Common Pests of Fruit Trees in Ontario, Canada. — CAESAR, LAWSON, Ontario Department of Agriculture, Ontario Agricultural College, Bulletin 250, pp. 1-118, 1 figs. Toronto, Ontario, July, 1917.

No attempt is made in this bulletin to discuss all the insect pests of fruit trees, but only the most common and the most to be dreaded economically. The description of each insect is followed by information concerning its biology and the most efficacious means of control.

APPLE TREE. — Codling moth (*Carpocapsa pomonella* L.); Lesser apple-worm (*Enarmonia prunivora* Walsh); Apple maggot (*Rhagoletis pomonella* Walsh); Fruit-tree leaf-roller (*Tortrix argyrospila* Walker); San Jose scale (*Aspidiotus perniciosus* Comstock); Oyster-shell scale (*Lepidosaphes ulmi* Bouché); European grain aphid (*Aphis avenae*); Rosy aphid (*A. rosae*); Apple leaf-aphid (*A. pomi*); Woolly aphid (*Eriosoma lanigerum* Hausmann); Mirids or leaf-bugs (*Heterocordylus malinus* Reuter, *Lepidocoridax mendax* Reuter, *Neurocoridax nubilus* Say and *Paracalocoris colon* Say); Apple tent-caterpillar (*Malacosoma americana* Fabricius); Forest tent-caterpillar (*M. dissimilis* Hubner); Fall canker-worm (*Alsophila pomonella* Harris); Spring canker-worm (*Pulex crataegi* Pack); Bud-moth (*Tortrix ocellana* Schiffenbauer); Cigar case-bearer (*Coleophora fletcherella* Fernald); Pistol case-bearer (*C. malivorella* Riley); Green fruit-worms (*Xylina* spp.); White-marked tussock-moth (*Hemerocampa leucostigma* Smith and Abbott); Fall web-worm (*Hyphantria cunea* Drury); Buffalo tree-hopper (*Ceresa bubalus* Fabricius); Round-headed apple-tree borer (*Saperda caddesi* Fab.); Plum curculio (*Conotrachelus nenuphar* Herbst.); Red spider (*Tetranychus bimaculatus* [T. *mytilaspidis* Riley?]); Fruit-tree bark-beetle or shot-hole borer (*Eccoptogaster rugulosus* Ratzeburg).

PEAR TREE. — Pear psylla (*Psylla pyricola* Forester); Pear slug (*Eccoptogaster limacina* Retzius); Pear-leaf blister-mite (*Eriophyes pyricola* genestecher); *Carpocapsa pomonella*; *Xylina* spp.; *Tmetocera bicellum*; *Coleophora fletcherella*; *Tortrix argyrospila*; *Hemerocampa leucostigma*; *Hyphantria cunea*; *Malacosoma americana*; *M. dissimilis*; *Aspidiotus perniciosus*; *Lepidosaphes ulmi*; *Eccoptogaster rugulosus*.

PLUM TREE. — *Conotrachelus nenuphar*; *Tetranychus pilosus* (*T. myspidus* ?); *Xylina* sp.; *Tmetocera ocellana*; *Coleophora fletcherella*; *Tortrix argyrospila*; *Alsophila pometaria*; *Paleacrita vernata*; *Hemerocampa costigma*; *Malacosoma americana*; *M. dissitia*; *Ceresa bubalus*; *Aspidiotus perniciosus*; *Lepidosaphes ulmi*.

CHERRY TREE. — Cherry fruit-flies (*Rhagoletis cingulata* Loew and *R. sta* Osten Sacken); Cherry aphid (*Myzus cerasi* Fabricius); *Eccoptogaster ulosus*; *Tmetocera ocellana*; *Tortrix argyrospila*; *Alsophila pometaria*; *ecrita vernata*; *Malacosoma americana*; *Ceresa bubalus*; *Aspidiotus perniciosus*; *Eriocampoides limacina*; *Conotrachelus nenuphar*.

PEACH TREE. — Peach-tree borer (*Sanninoidea exitiosa* Say); *Sesia ipes* Grote and Robinson; *Xylina* spp.; *Tmetocera ocellana*; *Malacosoma americana*; *M. dissitia*; *Aspidiotus perniciosus*; *Conotrachelus nenuphar*; *optogaster rugulosus*.

- Three-Lined Fig-Tree Borer. — HORTON, J. R., in the *Journal of Agricultural Research*, Vol. XI, No. 8, pp. 371-382, pl. 38-37. Washington, D. C., November 19, 1917.

The adult three-lined fig-tree borer (*Ptychodes trilineatus* L.) does considerable damage to fig-trees (*Ficus Carica*) in the south of the United States in Florida to Houston, Texas, and from South Carolina to the Gulf. It has been reported from parts of Mexico, British Honduras, Nicaragua, Costa Rica, Guatemala, Panama, the West Indies, Columbia, Venezuela, and Tahiti.

The adult causes some injury by feeding on the fruit, leaves and bark of fig-trees, and by ovipositing in the bark, but the greatest amount of damage is done by the larva. The larva mines into the larger branches and trunks of the trees and feeds upon the wood for a period varying from three months to a year. The insect lives both in dry and in green wood, and specimens have lived for two or three weeks in wood other than fig. It appears to prefer partly dead wood which has lost some of its sap to healthy green wood, and, therefore, chiefly attacks trees or branches which are injured or diseased.

A detailed description of the life-cycle and habits of the borer is given on page 371.

As the adult does not, as a rule, lay its eggs in the perfectly sound limbs or trunks of the healthy trees, it is most important to keep the trees in the healthiest condition possible. The larger branches and trunk are the parts particularly susceptible to attack. Bruising the bark, breaking the limbs, and all kinds of disease should be carefully guarded against. If a branch is accidentally broken it should be cut off at its base immediately and the end painted several times with a mixture of coal-tar and creosote. Infested branches should be cut off and burnt, as the borers will complete their development even in perfectly dead wood, and, later, attack other trees. Branches should be destroyed and never left in or near the orchard. Frozen branches should be cut off, diseased or bruised bark removed, and the wounds carefully painted.

Trees heavily infested in the bark, which can no longer be saved,



should be cut down, and every scrap burnt. The same should be done with badly damaged or dying trees, and the shoots which spring up from the roots of old fig trees.

In certain cases the eggs may be dug out with a knife or an awl; in this case it is necessary to be able to recognise the egg punctures and eggs. In small orchards ovipositing may be largely prevented by protecting the trunk and larger branches with wire-netting, which should be left on all the year. In some cases the borers may be killed by injecting carbon bisulphide into the tunnels and plugging the openings with putty, but this method is impracticable when infestation is severe and well advanced.

249 - *Oscinosoma discretum*, a Dipteron Observed in the Fruit of Wild Figs in Italy. — SILVESTRI, F., in *Bollettino del Laboratorio di Zoologia generale e agraria della R. Scuola superiore d'Agricoltura in Portici*. Vol. XII, pp. 147-154, figs. 1-1X. Portici, 1917.

While studying another dipteron — *Lonchaea aristella* Beck. — the author frequently found in the flowers of the wild fig tree, eggs and larvae of *Oscinosoma discretum* Bezzi in litt. (fam. Chloropidae). He describes the life history of this species, observed hitherto near Portici and Resina (province of Naples), so that it may be distinguished from *L. aristella* and the larvae of other diptera attacking the fruit of the wild fig.

The insect lays its eggs under the scales of the eye of the ripe flower and, though rarely, in the ripe second-figs, by placing them horizontally as does *L. aristella*. In one fruit may be found numerous eggs — more than 100 — of *O. discretum* alone or together with those of *L. aristella*. The newly-hatched larvae penetrate to the inside of the fruit and feed on the remains of the decomposing flowers and on the parenchyma of the wall of the fruit itself. When fully developed they leave the flower, which has usually fallen to the ground and pupate a few inches below the surface. Like *L. aristella* this species takes about 20 days to develop from the egg to the adult stage.

Although the eggs and larvae of *O. discretum* were abundant in the ripe flowers in June and July, 1917, and all the pupae produced perfect insects at the end of July or beginning of August, neither the eggs nor larvae of the species were found in many figs of the wild tree, during the rest of August. It was only on the 4th. September that the author found a few eggs of *O. discretum* in ripe second figs picked near Resina, whereas, in the same second figs, larvae of *L. aristella* were present in enormous quantities. So far, the author has never found eggs of *O. discretum* in figs of the good varieties, and, having found the eggs and larvae of the dipteron only in the flowers and ripe second figs, he doubts whether this variety lives normally in any other way. This must be settled by later studies; for the moment it is certain that *O. discretum* exists in abundance in the ripe flowers in June and July.

[248-249]

ALFREDO RUGGERI, gerente responsabile.

*In quoting articles, please mention this REVIEW.*

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The Editor's notes are marked (Ed.).